

Factors limiting science teachers from engaging learners in practical work: A case study

by

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DECLARATION

Student number: 58524665

I declare that an investigation into the factors limiting Natural Science, Grade 7 teachers from engaging learners in practical work: A Case Study of Ogongo Circuit in the Omusati Region is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

A handwritten signature in black ink, appearing to be 'H. K. K.', written over a horizontal line.

SIGNATURE

(Mr.)

17/08/2018

DATE

DEDICATION

This thesis is dedicated to my late parents. Gratitude to my father, Festus Mwakikange Kaindume, and mother, Adelheid Matheus for raising me to be the man I am today, and for your blessings and love. May your souls rest in peace.

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ABSTRACT

The main aim of this study is to determine what factors limit Natural Science, Grade 7 teachers from engaging learners in practical work or performing experiments. This study is conducted in the Ogongo circuit of the Omusati Region. A qualitative case study approach was adopted for the study. The sample includes two (2) Grade 7 Natural Science teachers and six (6) Grade 7 Natural Science learners. Semi-structured interviews and observations were used to collect data. Data from interviews and observations were analyzed using thematic analysis. All interview and observation transcriptions were categorized into codes, categories, and themes. Themes and subthemes were grouped into tables and linked to literature to strengthen the findings of this study. The main themes were lack of pedagogical know-how, time, laboratory materials, and training to update and practice appropriate teaching strategies/approaches. The results of the study recommend training to prepare teachers on the use of appropriate teaching to improve the teaching and learning of Natural Science. The study recommends that Natural Science teachers should share knowledge and facts concerning Natural Science to understand teaching and learning concepts better. The learners are afforded enough opportunities to judge, analyze, and draw conclusions from the supplied content based on their level of understanding of tasks. The study exposed factors limiting teachers practice and informs stakeholders on ways to improve Grade 7 science teaching and learning to overcome the challenges of the field.

Keywords:

Practical work, teaching, learning, practical activities, factors, science teachers

ACRONYMS

MEAC: Ministry of Education, Art and Culture

IT: Information Technology

DNEA: Directorate of National Examinations and Assessment

ORC: Outapi Regional Council

SAT: Standardized Achievement Test

NSC: Namibia schooling curriculum

NBC: National Basic Curriculum

ZPD: Zone of Proximal Development

UNESCO: United Nation Educational Scientific and Cultural Organization

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CHAPTER 1

INTRODUCTION AND BACKGROUND

1.1 Introduction

The focus of science education is to prepare learners to acquire scientific knowledge that they could use in everyday life (Lubben, Campbell, Kasanda, Kapenda, Gaoseb, Kandjeo & Marenga, 1998). In a study, Marshall (2010) argues that learning environments designed to advance science education must help learners to develop positive intellectual habits. These habits lead to new skills, such as creative thinking, problem-solving, leadership, and innovation. However, for both science and mathematics, the impact on learning and achievement depends on the approach to integration and the kinds of supports that are embedded in the experience and provided through classroom teaching. Acquiring scientific knowledge is in accordance with the knowledge-based society curriculum of Namibia that was introduced by the Ministry of Education, Art and Culture (MEAC) in 2005. This implies that science teaching ought to convey not only a collection of facts to the learners but ignite a way of thinking about the world outside the classroom.

The MEAC (2015: 44) reveals that the objectives of practical work in science education are captured under three domains. These domains are as follow:

Domain A: Knowledge with understanding.

Domain B: Handling information, application of knowledge and solving problems.

Domain C: Practical (experimental and investigative) skills and abilities.

Domain (A) focuses on subject matter content while domain **(B)** stresses the importance of handling information and solving problems and domain **(C)** focuses on the importance of practical work for the development of skills and investigations. For this study, **Domain B and C** are very important.

It is through practical work that learners may be involved in different activities that could enhance their abilities to handle information and solve problems and/or develop experimental skills to learn how to plan investigations. According to Nghipandulwa (2011), science teaching in Namibia is basically theoretical and teaching of practical work is neglected in most Namibian schools. The author argues that science teaching is dominated by theory-driven instruction, which leads to rote learning and teacher-centeredness as a way of teaching. In most schools, where practical work during science lessons is not conducted because of the inadequacy of teachers' professional

teaching skills. As a result, practical work or experimentation is neglected. Natural Science teachers seem to believe that using theoretical knowledge and teacher-centred approaches for science teaching and learning may be adequate to prepare learners in this field.

However, such an approach affects learning, because theoretical knowledge is not enough to make learning complete, therefore learners need to complement theory with practice in order to view the world from their own perspective (Nghipandulwa 2011). Science teaching has to be concerned with the development of analytical, critical observation and problem-solving abilities as well as the creativity of an individual (MEAC 2015). According to (Lubben et al. 1998; Kapenda, Kandjeo-Marenga & Kasanda 2002), practical work is central to teaching and learning of science and good quality practical work helps develop learners' understanding of scientific processes and concepts. These authors do not mention the investigation and teaching of science concepts which is key to science inquiry and practice.

Research, Kapenda et al. (2002) show that a quarter of the science teachers in Namibia do not teach practical work at all. Practical lessons are being scheduled but do not represent 'full practical lessons', that is, where learners have hands-on experiences (Kapenda et al. 2002). It is further revealed that several practical activities only introduce answering worksheet questions which are unrelated to the practical activities opposed to aligning these questions to the science concepts taught. In many cases, recording observations or measurements are seen as peripheral.

During science lessons, drawing on conclusions or making generalisations from the results of experiments is done orally (Kapenda et al. 2002) within a Namibian science teaching and learning context. Teachers' practical teaching skills remain under-developed and are hindered by teacher-centred beliefs and approaches. It is commonly known that the teacher-centered approach promotes and focuses on mastery of content knowledge, with less emphasis on the development of skills and the nurturing of an inquiring attitude (Lubben et al. 1998).

Therefore, there is a need for practical application, investigation and experimentation during science lessons to prepare learners to become future scientists. A proper understanding of science concepts could be achieved through practical teaching activities which will enable learners to

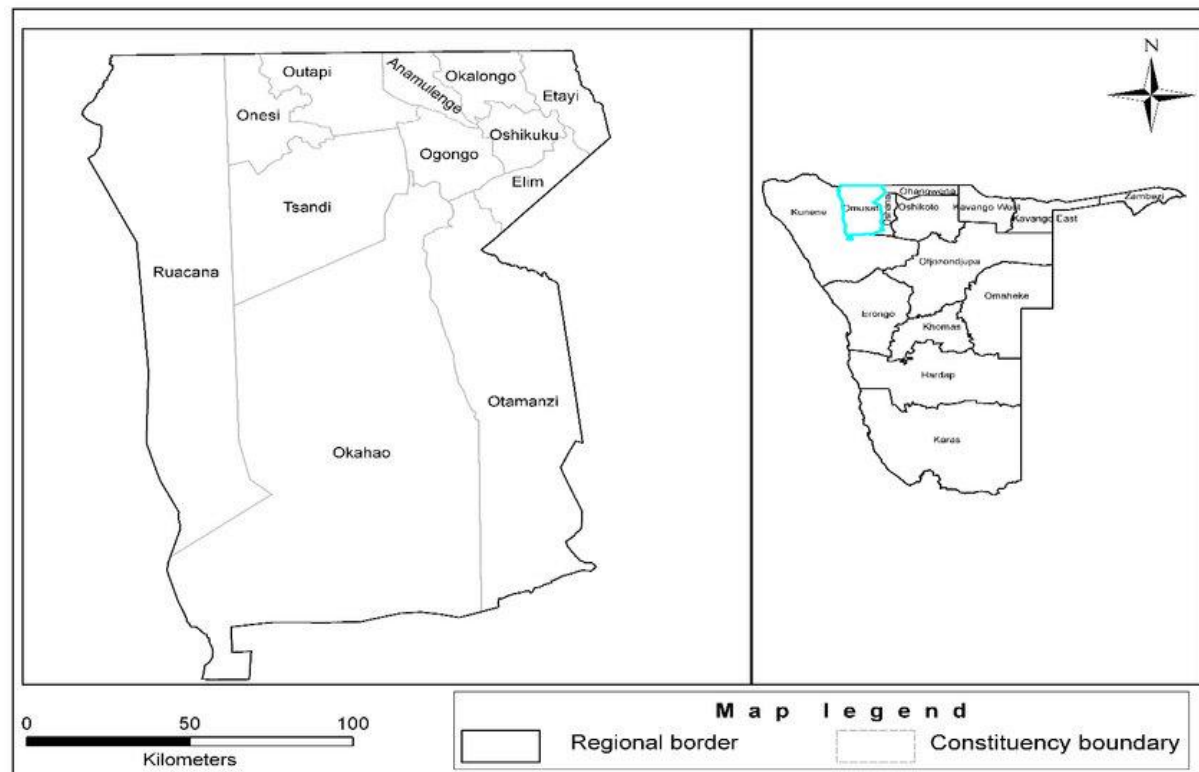
acquire important scientific skills such as collecting and recording data, communicating, analysing and making inferences (MEAC 2015; Dillon 2010; Kapenda et al. 2002).

In a report, Department of National Examinations and Assessment (DNEA) (2015) it is further revealed that upper primary and junior secondary teachers are faced with the challenge of teaching practical work, a factor that restraint learners' performance in science subjects especially at junior secondary school level (MEAC 2015).

1.2 Background of the study

Omusati region is located in the north of Namibia and among the fourteen regions of the country. Outapi is the main town in this region. This region is known for several Mopani tree species. However, the Makalani palms decrease rapidly westwards from the border with Oshana region (Population & Housing Census 2011). According to ORC report (2010) Outapi is the fastest growing town in the Omasati region. Many people migrate from the rural surrounding areas to this town. Although the town is not overpopulated, the rate of unemployment is very high and the majority of people depend on the agricultural sector to sustain their livelihoods. In this region crop farming is practised, and mahangu is successfully cultivated. The main water source is the Ruacana river. Figure 1 shows the Omusati region and the region within the Namibian map.

Figure 1: Omusati region map



Omasati region map

The Ogongo town is located between Ruacana and Outapi. There is a government-owned farm called Etunda irrigation farm, where several crops such as mahangu, maize, watermelon, tomatoes, and bananas are grown. Water from this canal is used to irrigate the farm. People from the Outapi town, Ogongo and Ruacana are employed at the farm which provides their daily food sustenance (Population & Housing Census 2011).

The Omasati region has a tarred road that is linked to the main road from Outapi, Okahao through Ondangwa, and Eenhana to the Kavango region. Even though this road is of poor quality, it provides a gateway to major northern towns. In both Okahao and Outapi are small hospitals, and a network of health clinics that provide basic health services. The Namibian Ministry of Education provides adequate resources for education in this area.

1.3 Rationale of the study

The purpose of this study is to identify the factors that limit Grade 7 Science teachers from doing practical work. Acquaintance with topics and teaching approaches of science allow teachers to be

able to confidently use these teaching and learning approaches. Primary school teachers generally have some difficulties in teaching science and technology (Huyugüzel Cavas & Kesercioglu 2008). Teacher training ought to prepare science teachers during training courses to be prepared for teaching. As a result, primary school teachers should have competencies in understanding several disciplines as well as interdisciplinary topics (Kahramanoğlu & Ay 2013). The current Namibian Upper Primary Natural Science curriculum (Grade 4-7) advocates learner-centred approaches with learners' active involvement in practical activities to promote scientific skills (MEAC 2015).

According to the Namibian Ministry of Education, learners perform poorly in Natural Sciences countrywide. It is further revealed that only a few schools use practical work when teaching Natural Sciences (MEAC 2008 & 2009). Consequently, the use of practical teaching and learning approaches for upper primary Natural Science in the Ogongo circuit, Omusati region, lack practical teaching activities from primary school level which may result in learners' poor performance at the national level in Grade 10 and 12 (MEAC 2015: 44). Factors influencing science performance range from shortage of qualified science teachers, poor facilities, equipment and instructional materials for effective teaching, use of traditional 'chalk and talk' methods, large learner to teacher ratios to mention but a few. Other challenges involve teacher's variables such as teacher self –efficacy, interest, attitude, qualification and experience (Tella 2008).

1.4 Statement of the problem

Opportunities for learners to gain skills through science practice in Namibia are rare. Research, (Roth & Garnier 2007; Barton & Tan 2009; Maskiewics & Winters 2012) indicate that most science instruction limits opportunities for learners to learn science practice by promoting the completion of curricular activities rather than sense-making, rarely taking learners' prior knowledge into account during lessons, seldom pressing for evidence-based explanations, and treating learners' ideas as incongruent with canonical science. There is broad consensus that Natural Science teaching requires practical work in an effective and engaging way.

Research of science education in Southern Africa has highlighted a number of challenges which affect teaching and learning of practical activities in science teaching. Mudau and Tabane (2015) state that most teachers of Southern African countries face challenges when teaching practical work during science lessons. These challenges include negative perceptions toward practical work

because practical work is not seen as the basis for the development of a substantive understanding of concepts of science as a subject. The presentation of practical work may enhance learners' comprehension of concepts which is hampered by the lack of apparatus and other contextual factors like overcrowded classrooms.

In addition, Mudau and Tabane (2015) cited Dudu and Vhurumuku (2012) who attest that teachers mostly focus on the mastery of the subject matter rather than practical work when teaching Natural Science. In doing so, teachers neglect an important aspect of science teaching. Mudau and Tabane (2015) assert that practical work must be integrated with the theory to strengthen the concepts being taught. These may take the form of simple practical demonstrations or even an experiment or practical investigation. It is against this background that this study investigates factors that contribute toward lack of practical work in Natural Science, Grade 7 in the Ogongo circuit of the Omusati region.

In order to meet the needs of the upper primary Grade 4-7, Natural Science curriculum, there is a need for an investigation to determine the factors limiting teachers from using practical work, investigations or experiments during science lessons.

1.5 Research goal

The main aim of this study is to determine the factors limiting Grade 7 Natural Science teachers from engaging learners in practical work.

1.5.1 Question of the study

The following question guides this study:

- What are the factors limiting Grade 7 Natural Science teachers from engaging learners in practical work?

1.6 Significance of the study

There is a need to investigate the factors limiting Grade 7 science teachers' teaching of practical work. Curriculum developers need to plan broad guidelines on how to effectively prepare teachers for the implementation of the curriculum. Thus, it is necessary to consider all aspects during the planning and implementation phase of teaching and learning. The study is significant for teachers, curriculum developers and policy makers to include content and context to science teaching,

curriculum and policy to enable learners to benefit from teaching and learning to gain skills and be able to solve real-life scientific problems. The study directs further research to assess primary school teachers' pedagogical practices to enhance teaching and learning of science and adds to the scientific knowledge base for teaching and learning of upper primary science education in Namibia.

1.7 De/Limitations of the study

This study was limited in the following ways: First, the study involves two science teachers and four Grade 7 learners within the Ogongo circuit of the Omusati Region, which is located in only one of the 14 education regions of Namibia. Therefore, generalizations outside of this demographic context should be done with caution. Furthermore, although the data obtained from these teachers and learners provide some preliminary evidence regarding factors that limit teachers' teaching of practical work, a larger sample of science teachers could be used to verify the consistency of the findings. Furthermore, the study was limited by time and resources to collect data within a larger demographic scope.

1.8 Research methodology and design

According to Rajasekar (2013), research methodology is a systematic way to solve a problem. It is important for the researcher to know not only the research methods necessary for the research undertaken but also why the methods used were suitable for the study. Some researchers thought that knowing how to find the solution to the root cause of the problem is the key in research but what is important in research, is the order of accuracy of the result and the efficiency of the method used to collect data (Sahadevan & Lakshmanan, 2002). Therefore, the researcher has explained the methods to conduct the study and justifies why the methodology was suitable for the study.

This design and methodology of this study are based on qualitative research. A case study is used to investigate the factors limiting Natural Science teachers from engaging learners in practical work. The study is explorative and descriptive in nature since qualitative research aims at providing descriptions of the phenomena that occur naturally, without the use of experiments (Merriam 2009).

1.8.1 Research paradigm

This study used an interpretive paradigm, which considers the experiences of individuals as the main source of interpreting reality. According to Cohen, Manion & Morrison (2007), an interpretive paradigm allows the researcher to understand the phenomena being studied and interpret explanations of the phenomena given by the participants. This research paradigm is selected because the researcher focuses on the interpretation of factors which contribute to the lack of practical work in teaching Natural Science at Grade 7, in the upper primary phase. Cohen et al. (2007) state that the advantage of using interpretive research is to provide a rich description of the phenomenon being studied.

Therefore, this study intends to use an interpretive approach to explore and to gain a deeper understanding of the contributing factors limiting science teachers from engaging learners in practical work in Grade 7, upper primary phase in the Ogongo circuit of Omusati region.

1.8.2 Qualitative research

The study employs a qualitative research approach because it gives the researcher the opportunity to understand practical work during science teaching and learning practices, views, and opinions of science teachers to determine the factors contributing to the lack of practical work in Natural Science teaching of Grade 7.

A qualitative research approach was an appropriate approach because it complements and attempts to investigate the phenomenon in a natural setting and focuses on understanding the social phenomenon holistically in its entirety (Merriam 2009). According to Bassey (1999), the qualitative research approach is characterised by the description and interpretation of the world of the participant in the context of the study in an attempt to get shared meanings of others.

In doing so, it complements the interpretative orientation by giving the researcher the opportunity to explain and describe the phenomenon as perceived by the participants (Merriam 2009). Thus, to understand teachers' experience, it was essential to study participants in their real context (Creswell 2008). Hence, this approach allowed the researcher to make detailed and rich descriptions of Natural Science teachers' views and opinions of teaching practical work during science teaching at the upper primary level.

1.8.3 Research strategy

The study employs a case study as an appropriate method of qualitative research. A case study has been described as useful to study a process, programme or individual in an in-depth, holistic way that allows a researcher to get a deeper understanding (Merriam 2009). As Merriam (2009) stated, the case study design is used to gain an in-depth understanding of the situation and meaning for those involved. Merriam (2009) emphasizes a case study as a process of investigation to understand a situation.

Patton (1990) suggests that a case study is helpful in gaining deeper understanding of particular people, problems or situations in comprehensive and relevant ways. According to Bell (1993) cited by Merriam (2009), the greatest strength of the case study method is to allow the researcher to concentrate on a specific instance or situation and to identify or attempt to identify the various interactive processes at work. In this regard, case study methods helped the researcher to identify factors that contribute toward the use of practical work in Natural Science in the upper primary phase, Grade 7.

1.8.4 Selection of setting and research participants

Two Grade 7 Natural Science teachers from the two schools in the Ogongo circuit in the Omusati region were purposively selected to participate in the study. Learners were randomly selected from the classrooms to participate in the study. Purposive sampling was suitable for this study because it focusses on particular characteristics of a population that was of interest, which best enabled the researcher to answer the research questions (Creswell 2008). The criteria of the selection involved that: 1. Participants are natural science teachers, 2. Participants must be full-time employed at the selected schools in the Ogongo circuit of the Omusati region, 3. Participants have at least two years of teaching experience.

1.8.5 Research instruments

Interviews and observations were used to collect data for this study. The use of these two instruments allowed for the generation of a rich wealth of data to answer the research question.

Semi-structured interview

McMillan and Schumacher (2006) described semi-structured interviews as questions that are organized around areas of particular interest, while still allowing considerable flexibility in scope and depth. In the semi-structured interview, the researcher has looked at how Natural Science

teachers teach without engaging learners in practical work, solicited the Natural Science teachers' perceptions on the importance of practical work, how teachers perceive the use of practical work when teaching Natural Science, and the challenges that teachers face when teaching practical work during science lessons.

Observations

Classroom observations can lead to deeper understanding than an interview because it provides knowledge of the context in which an event occurs and enables the researcher to see things of which the participants themselves are not aware of and are unwilling to discuss (Patton 1990). Practice science teaching were observed to find out how teachers engage learners in practical work. Cohen et al. (2007:396) note that "what people do may differ from what they say they do." These authors also note that an observation enables a researcher "to look at everyday activities and behaviour that otherwise might be taken for granted or go unnoticed" (Cohen et al. 2007:398). Two lessons of two teachers were observed and video recorded.

1.8.6 Data collection procedure

The researcher has sought permission from the Omusati region education director to access schools and requested teachers' consent for participation in the study. The letters were sent through the Omusati director's office to the principals of the two schools to seek permission to do the research at the selected schools. The researcher has also explained the purpose of the study to the participants and discussed the ethical issues with the participants.

Two Grade 7 Natural Science teachers from two schools in the Ogongo circuit in the Omusati region were interviewed and three lessons were observed. The interviews were audio recorded with the permission of the participants. In total, two practical lessons and one lesson without practical work were observed.

1.8.7 Data analysis

Thematic analysis was used to analyse the data (Braun & Clarke 2006). Patton (1990) states that the interpretive researcher tends to use qualitative research to see how themes emerge from the data generated. McMillan and Schumacher (2006) state that qualitative data analysis in most cases uses an inductive process to organize the data into categories and identify patterns according to different themes.

On the other hand, Cohen et al. (2007) describe qualitative data analysis as a systematic process of coding, categorizing, and interpreting data. Thematic analysis was suitable for this study because it involves reducing accumulated data to a manageable size, developing summaries, and looking for patterns. Coding was used from the beginning of data generation to break down the data into manageable pieces. Themes were identified and linked to literature to help the researcher in answering the questions about the teachers' use and perceptions of the importance of practical work and the challenges teachers faced in teaching practical work in Grade 7 Natural Science.

1.9 Validity and trustworthiness

According to Bassey (1999: 75), "validity is the extent to which a research fact or finding is what it claims to be." To ensure the validity and trustworthiness of the study, the study used two methods of data collection - semi-structured interviews, classroom observations, and document analysis.

The use of multiple methods helped the researcher to triangulate and to build on each type of data collection while at the same time compensating for potential weaknesses in any single approach (Patton 1990). Triangulation was used to complement and look for consistency, patterns, and discontinuities in the data collected. This process ensured valid and reliable data which constructed a diverse set of realities from teachers' views and opinions of their teaching practices.

For the validity and trustworthiness of this study, interpretive validity and descriptive validity are used. According to Maxwell (1992: 288), interpretive validity can be described as, "appropriate primarily because this aspect of understanding is most central to interpretive research, which seeks to comprehend phenomena, not on the basis of the researcher's perspective and categories, but from the participants in the situations studied."

The study has ensured that constructs presented by participants are accurate. The interpretation of interviews and observations relied on the participants' own words and concepts collected from data. As indicated earlier in this chapter, observations and interviews were audio-tape recorded to capture the data and reflect on how participants perceived practical work in science teaching. Interview transcripts were created and provided a thick description of the participants' views. The views of participants were provided in thematic themes and substantiated by narratives (See Chapter 4).

The study used to follow up discussions after the observations and member checking of interview transcripts to share the interpretations with the teachers in order to corroborate the data. Reflexivity was considered throughout the research process. Bassey (1999) states that interpretive research requires researchers to be aware of the standpoint from which they conduct the research. As a researcher, I was deeply aware of my biases as a Natural Science teacher and tried to interpret the data from the participants' views. The researcher made reflective notes throughout the data collection process. In order to guard against any biases, the researcher has examined any assumptions critically as potential threats to validity. The researcher has avoided to 'prove' a particular perspective or manipulates the data to arrive at predisposed truths (Patton 1990). "The study understood the world as it is, to be true to complexities and multiple perspectives as they emerged, and to be balanced in reporting both confirming and disconfirming evidence" (Patton 1990: 55).

1.10 Ethical considerations

McMillan and Schumacher (2006) state that "since educational research naturally involves humans as participants, researchers are required to protect the rights of the participants of the study" (p.16). Therefore, informed consent letters were written beforehand to the participants and school principals to obtain permission for the study and to get participants' agreement for participation (See Appendixes 5, 7 & 8). Ethical clearance was obtained from UNISA, College of Education. The ethical clearance certificate was granted on 2017/06/14, Reference number 2017/06/14/58524665/28/MC (See Appendix 3).

The study involved two Grade 7 Natural Science teachers in Ogongo circuit. Cohen et al. 2007: 58 cited Cavan (1977) who defines ethics "as a matter of principled sensitivity to the rights of others and while the truth is good, respect for human dignity is better".

Bell (1993) argues that no researcher can demand access to an institution or materials. The participants were informed about the aim of the study and they had the opportunity to choose whether to participate in the study or to withdraw at any point in time during the study if they may feel uncomfortable with any activity or questions without any obligation. The participant names or any identifying information are not disclosed in the report writing and data generated from the

research are kept confidential. To ensure anonymity the names of the participating schools and teachers are not disclosed in the research.

1.11 Definition of key concepts

Practical work: Refers to a component of science teaching that focuses on the investigation of the phenomenon through hands and minds inquiry. It is seen as hands-on, or minds - on practical learning opportunities by students or learners (MEAC 2015). In this study, practical work is referred to as experiments or hands-on practical activities.

Science teacher: A science teacher is defined as someone who interprets and implements the Natural Science curriculum through teaching and learning processes (Namibian Ministry of Education 2008). This study refers to a science teacher as a person who has undergone fulltime training in an educational institution.

Factors: Are defined as elements that limit or hinder something which contributes to a particular result or situation (Nghipandulwa 2011). Factors attributed to the outcomes of teaching and learning.

Teaching strategy: It refers to an explicit and interactive teaching strategy that engages active learner participation, collaboration, and investigation to explore scientific phenomena.

1.12 Chapter division

Chapter 1 covers the introduction and background of the study. This chapter also gives a synopsis of the problem statement, research aim and question, research methodology, ethical considerations, key concepts as well as the chapter layout.

Chapter 2 discusses the literature review and identifies gaps in the literature.

Chapter 3 deals with the research design and methodology.

Chapter 4 covers data analysis, interpretations, presentation and discussions of the research findings.

Chapter 5 comprises of the finding summary, conclusion based on the study objectives and recommendations of the research under study.

1.13 Summary

This chapter 1 presents the background of the study. An orientation of science teaching and learning within a Namibian context is outlined. This chapter also presents the rationale, purpose statement, research questions, de/limitations, significance, research methodology and design. The research methodology presents the research paradigm, strategy, selection of participants, instruments used, data collection and analysis, validity and ethical considerations of the study. Key aspects of science teaching and learning are highlighted and discussed. In the next chapter, the literature review of the study is outlined.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter presents a literature review of the study. The study is situated within Piaget's social constructivist and Vygotsky's socio-cultural theory. A conceptual framework of practical work is presented, the factors affecting both science teaching and the quality of teaching, assessment of learning as well as stakeholder engagement amongst others. The study also examined the perceptions of science teachers towards practical work and determined measures that could be used to help Natural Science teachers to cope with challenges that arise with practical work. The definition of practical work is presented first.

2.2 Definition of practical work

Allowing learners to experience science through various forms of carefully designed practical work including experimentation, often support their learning and motivate their engagement whilst fulfilling specific curriculum requirements. Practical work is defined differently by different researchers. Millar (2004) and Rollnick (2003) define practical work as any learning and teaching activity that involves learners observing or manipulating objects and materials. In this study, practical work refers to practical or experimental science teaching and learning. In the literature reviewed, Millar (2004) and Tsai (2003) indicate that practical work is laboratory-based work that embraces of experimentations which give learners laboratory-based experience. This implies that experiments are accepted as a type of practical work that engages learners in practical work, through which they gain experience based on what is experimented.

According to Daniels (2004), laboratory activities are learning experiences through which learners interact with materials, observe and understand their natural world. Maselwa and Ngcoza (2003) state that practical work is the teaching and learning circumstances that offer learners the opportunity to engage in research of some kind. Millar (2004) argues that it must include pro-active and minds-on learning and teaching opportunities to assist learners in developing various skills. Therefore, practical work must be used in the everyday lessons to enable learners to use their minds and their hands to develop observation, questioning, data collection, manipulation of objects, and data recording skills and other skills required to do practical work.

2.3 Practical work within a Namibian context

Since 1990, the National Basic Curriculum (NBC) of Namibia has undergone multiple changes and adopted a learner-centred education approach toward teaching and learning, which also give rise to competency-based education (Cargan 2007). This change of the curriculum from competency-based education to a revised national basic education curriculum, national curriculum statements (NCS), including early childhood and pre-primary education, vocational, and institutional grades has triggered several misconceptions amongst educators. Curriculum policies of Namibia were implemented and have different goals and proposed outcomes for student learning. A standards-based curriculum focuses on learner-centred education. During classroom observations, it was noted that a teacher-centred teaching approach is common in practice throughout the Namibian curriculum. A learner-centred teaching approach focuses on what the learners do in order to learn rather than what the teacher does.

In 2000, the Namibian government introduced the basic education curriculum in primary and senior primary schools. The basic curriculum has three distinct features i.e. learner-centred education, integrated approach to computer literacy and information technology and the introduction of multi-national languages. English is the medium of instruction from grade 1-10. This introduction presented a shift in the curriculum on how teaching and learning could be understood by both teachers and learners (Dillon 2010).

Garrett (2010) argues that the implementation of the curriculum was driven by the political interest that lacked the experience of the classroom realities. However, the current curriculum considers practical work in the form of practical tryouts, research, sit-in, skill enquiries and projects. According to the basic curriculum, practical work has to be “assimilated with the theory to strengthen the concepts being taught. This goal aimed at developing learners’ skills such as problem-solving and scientific inquiry, reflections, scrutiny, drawing conclusions, and data collection (George 2006).

The introduction of the basic curriculum provided the opportunity for more regulated learning programs opposed to the scheme of work which was central to teaching before. As a result, teachers have less responsibility with regard to the interpretation of the curriculum outcomes (Singh 2014). The curriculum supports the use of practical work and is broken down into three

units i.e. a section for ‘practical activities’ including experiments, practical demonstrations that are used in strengthening basic ‘experiments.’ These demonstrations refer to bounded instructions that learners can follow when obtaining results to verify theories. Finally, ‘practical investigation’ requires learners to go through basic scientific enquiry processes (Hicks 2001).

According to the basic curriculum document, the teaching of science in the curriculum should include the understanding of how scientific enquiry is conducted, the kinds of intellectuals that scientist use in linking data and explanations, the claims scientists make, and the roles that the scientific community adopt to verify knowledge claims (Hicks 2001).

Therefore, the expectation is that learners must be able to conduct experiments, investigations, demonstrations, and projects of enquiries as part of their continuous assessment. These activities are meant to equip learners with research skills and encourage them to be aware of their environment (Barmby, Kind & Jones 2008).

The basic curriculum had its own challenges. These involve teachers’ inability to translate and understand the NBC and to link its objectives to practice (Nakedi 2014). It is important to note that NBC document accepted the same principles as that of its post-independence curriculum. Cargan (2007) states that the main aim of NBC document was to use a competency driven curriculum to ensure shifts from the teacher-centred approaches to learner-centred approaches.

Given the nature of practical work, there is a need for clear strategies for the use of practical work in the National Basic Science curriculum of the country. In the critique of the curriculum, one would argue that there is a need to put measures in place to support in-service teachers to implement the curriculum appropriate to the benefit of learners. These measures may include continuous professional development and ample school-based support in working groups to link the curriculum goals to practice. Lack of appropriate training to gain pedagogical skills may hamper the implementation of the NBC. In the next review, different types of practical work are highlighted.

2.4 Types of practical work

According to Mudau and Tabane (2015), types of practical work include projects, investigations, inquiries and field trips. From the literature reviewed, practical work comes in different forms providing learners with practical exposure and engagement independently. Several studies, (Andrews 2012; Dlamini 2008; Jokiranta 2014) reveal that survey-based learning through trial

work advance learner's practice skills. Ary, Jacobs, Sorensen, & Razavieh (2009) similarly contend that applied work includes small groups doing workroom practice which does not include teachers' sit-downs. This implies that applied work is not considered practical work because practical work must involve a group of learners engaging in doing something on their own and with little guidance from their teachers. However, explicit teaching and guidelines may promote learners' inquiry skills.

On the other hand, Bennett (2005) views applied for work as the movement that promotes discovery learning that advance learners' thinking at a later stage. This suggests that if a learner discovers something, the discovery will be influenced by the movements occurring during observation in the practical tasks. The next review outlines the purpose of practical work.

2.5 Purpose of practical work

Dillon (2010) identifies several purposes for practical science, e.g. Science as universal education as well as training for future career paths. The evidence is presented that teachers and pupils have to engage in practical science if they have to benefit from it. The success of learners and teachers in science is influenced by the number of experiments and investigations during room work. Therefore, it is of vital importance that "science without practical is like swimming without water" (Bennett 2005). When teachers fail to include practical work in science subject motivation and learning of science will be beyond the expected norm. Therefore, engaging in practical activities in science are key to motivate learners, and to stimulate learners' interest to learn science (Bennett 2005).

Many researchers emphasize the need to make the purpose of practical work explicit to learners (Jenkins 2006; Kim & Song 2009; Lakshmi 2004). Murphy and Beggs (2003) stress that the teachers' goals for practical work are often limited especially because practical work influences multi-intelligences of learners. In particular, the value of group work does little to what practical work is supposed to do to an individual learner.

At one hand, the challenge of individual difference and lack of group association makes some teachers behave as if the reason why learners work in groups is just to cover the subject syllabus and not to inquire more of what science may bring the classroom (Owen, Dickson, Stanis Street & Boyes 2008).

Lack of science facilities, equipment and laboratory apparatus affect the purpose of practical work because it could be useful to pay more attention to the encouragement of interpersonal skills through group work to enhance speaking and listening skills during discussions of science when engaging in practical activities (Sandoval 2003). Practical work for procedural knowledge plays an important role in science teaching and is discussed next.

2.6 Practical work for procedural knowledge

Practical work is regarded as part of the teaching and learning process that involves learners in manipulating objects under study (Andrews 2012). Learners have the opportunity to judge, analyse, and draw conclusions based on their understanding of the task.

Based on these procedures practical knowledge is supported. Dillon (2010) refers to concepts of substances. Dillon (2010) argues that perceptions of substances form a knowledge base is connected to the substantive intangible base that is at the heart of science. This notion implies that a teacher should be conscious of knowledge associated with open inquiries, which needs to be taught because it does not come automatically when engaging learners in practical work (Lester 2003).

In scientific inquiry, learners are required to plan a progression of action, assemble necessary data and reach assumptions in one way or another (George 2006). The difficulty of practical action is required to be developed by the learners themselves and the teacher has to activate them. Therefore, teachers play a critical role in engaging learners in practical work.

2.7 Role of practical work in science as a subject

Swain, Monk and Johnson (1999) argue that practical work provides learners with an insight into real-world experiences. As a result, practical work as a component of teaching necessitates teachers to be equipped to provide these experiences hands-on to learners. Millar (2004) states that practical work should be designed effectively. He also reveals that science is characterised as a product, process and an enterprise that allows learners to develop various skills.

Furthermore, Maselwa and Ngcoza (2003) reveal that most learners participate and enjoy practical activities, especially when these activities are well-planned. These authors further indicate that practical work stimulates discussions and provoke arguments which may enhance learners' conceptual understanding of science. According to Yoon and Kim (2010), cited by Sitole (2016),

practical work helps learners to develop an understanding of science, appreciate that science is based on evidence, and acquire hands-on skills that are essential for learners to progress in science. Sitole (2016) asserts that practical work is a useful tool to situate learners towards scientific inquiry to develop process skills. Practical work is seen as promoting scientific knowledge which includes learning of concepts, modelling and the development of scientific inquiry abilities.

Millar (2004) argues that the importance of practical work is accepted. However, it is crucial that departments of education and curriculum developers ensure that it supports teaching and learning. In order to see the purpose of practical work, knowing what learners do in laboratories give value to education and to practical work.

Abraham and Saglam (2010) further argue that practical works' aim is to promote simple scientific methods of thinking while Kempa (1986) see practical work as central to playing an important role in science education. Abraham & Millar (2008) believe that practical work is an essential part of learning and teaching Natural Science and to promote conceptual change in thinking.

Pekmez, Johnson and Gott (2005) believe that practical work is the movement of knowledge that drives inquiry and analysis. This means that practical work helps learners to discover the reality of nature to develop their thinking continually. This suggests that if a learner discovers something, he/she is learning and that discovery is influenced by his/her opinions occurring during observations and during practical tasks.

2.8 Inquiry-based science teaching

Inquiry-based science learning has become more favoured over traditional teaching methodologies in this field. Recent technological advancements increase the success of applying inquiry-based learning even more (de Jong, Sotiriou, & Gillet 2014). In Inquiry-based learning, learners often carry out a self-directed, doing experiments to investigate the relations for at least one set of dependent and independent variables (Wilhelm & Beishuizen 2003). Inquiry-based learning emphasizes active participation and the learner's responsibility for discovering new knowledge. In inquiry-based learning environments, learners perform experiments or activities individually or in groups. As a result, knowledge becomes meaningful, thus developing individual and more

permanent thoughts. There is a need to promote inquiry-based teaching and learning for science teacher training in Namibia.

2.9 Social constructivism in teaching and learning Natural Science

The study is informed by social constructivist and socio-cultural theories. Most teaching strategies lead to a positive change to improve primary school learners' knowledge and behaviours. The researcher draws on Vygotsky's socio-cultural theory and the notion of the 'zone of proximal development' (ZPD) to understand how teachers, implement practical work in the classroom.

Social constructivism guides many researchers while explaining the importance of teaching and learning science (Moll 2002; Daniels 2004). The teacher should not try to impose knowledge on the learner but should stimulate learning with materials that interest the learner and challenge him/her to solve problems on his own (Piaget, 1968: 151). This implies that learners need opportunities to experiment, investigate and make meaning on their own. In a review of the literature, Daniels (2004) describes social constructivism as an act of acquiring knowledge that is constructed socially by human beings when working with others. According to social constructivists, knowledge cannot be achieved by an individual but it can be acquired through social processes (Daniels 2004).

Therefore, classroom interaction is important. It engages learners into interaction with their peers, teachers, as well as with the learning materials to construct knowledge. In teaching and learning of science, interactions may be hampered by teachers' attitudes and their inability to prepare lessons that support inquiry-based learning. These factors negatively influence the teaching and learning process during practical work.

In addition, social constructivists argue that teachers cannot transfer knowledge from their heads to the students and that students construct their own knowledge through negotiation within their social setting (Daniels 2004). This theory implies that during the teaching and learning process a teacher should be the facilitator, not an instructor. Vygotsky's interest in the development of scientific concepts can be seen as part of his more general concern to explain the development of what he called the higher mental functions and, in particular, decontextualized thinking. The role of the teacher is to provide scaffolding so that the learners can accomplish a task which they

couldn't otherwise have completed individually, thus helping the learners through the zone of proximal development (Moll 2002).

In teaching and learning science, teachers should provide a learning environment that promotes students' understanding through meaningful peer and teacher interactions (Maselwa & Ngcoza 2003). In other words, the social constructivist theory emphasizes learner-centred approaches and learning through hands-on activities in which learners work collaboratively to develop their understanding. In line with the new revised Namibian Natural Science and Health education syllabus for upper primary, learners learn best when they are actively involved in the learning process through participation, contribution, production and the acquisition of knowledge (MEAC 2015).

Moreover, science deals with scientific ideas which are within students' environment and these ideas must be tested against their prior beliefs (Maselwa & Ngcoza 2003). Therefore, engaging students in practical work will enable them to challenge and reconstruct their existing ideas and make contextual scientific learning possible. Furthermore, practical work helps to substantiate scientific knowledge and understanding; hence, it is hard to imagine learning about science without doing practical work (Maselwa & Ngcoza 2003).

Practical work engages students in the investigation through data collection, interpretation and making inferences. Consequently, the teaching of science which does not incorporate practical work is out of step with the ideals of science teaching (Maselwa & Ngcoza 2003) because students may not be able to connect theoretical scientific concepts with the real world they live in.

Therefore, the notion of ZPD refers to novice learners who work with teachers and more experienced peers in collaborative problem-solving activities to acquire skills that they are not able to acquire on their own. This will help in understanding how teachers prepare learners for practical work and how they implement practical work when teaching science. In both the socio-cultural and constructivist teaching environ, teachers, find it difficult to get around matters of classroom management. Richardson (1997) cited the critique of this form of education that focuses on the social element of learning such as the power relations among teacher, learners, and the subject knowledge.

2.10 Factors that impede practical work

In the literature reviewed, many reasons are cited why practical work remains a challenge in teaching and learning. One of these reasons is lack of funds. Kim and Song (2009) state that poor laboratory facilities become barriers to individual laboratory work, therefore, teachers resort to teacher demonstration during lesson presentations.

Other studies point to factors beyond resources, arguing that if practical work is not used effectively, it can result in various difficulties during its execution. Millar and Abrahams (2008) and Hart, Mulhall, Berry and Loughran (2008) report that for most children the activities and what goes on in the laboratory often subsidizes little to their learning of science, resulting in lack of understanding of the purpose of practical tasks.

The propose of the use of practical work in many schools is not fruitful and learners do not usually benefit from it. The challenges experienced to promote effective practical work, include the shortage of materials. Treagust (2002) argues that the role of practical work in schools is being imprecise in science education.

UNESCO (2000) indicates that the extent of the use of practical and laboratory work in science teaching may not necessarily be related to attainments in science. As early as the 2001's, Dahar and Faizer (2011) pointed out that most teachers use practical work carelessly and that their approach was more hands-off rather than hands-on.

In their study, Lunetta, Hofstein and Clough (2007) oppose that, for most teachers and learners, there is still a stretched way in understanding the research laboratory approaches used, activities and the natural surroundings of relations in practical work.

Some studies debate that educators are frequently the reason why practical work has complications. In a study, Weil-Barais (2001) claims that educator's interpretations about practical work may or may not imitate their genuine teaching space practices. Yoon and Kim (2010) point out that these teachers in most cases spring weight to measures when doing practical tasks, instead of the aftermaths of the task. Lack of knowledge and teaching expertise contributes toward teachers inability to deliver quality teaching and learning experiences.

In a review of the literature, Singh (2014) establishes that teachers hassle the importance of practical work in their classrooms, but their intentions were not attracting technical inquiry since they do not esteem inquiry as important. Furthermore, Samaras (2002) states that a number of teachers do not contemplate the ordinary use of practical work results in the attainment of skills. Ramnarain (2011) argues that workroom tasks are considered as such for learners to monitor the methods systematically, rather than making their own meanings and decisions which may have little impact on their understanding of science through practical work. There is a need for an in-depth study to determine the shortfalls of Namibian science teaching and learning.

Abrahams & Millar (2008) indicate that the problems regarding practical work may rise due to learners not being considerate with the given instructions and procedures in situations where apparatus is inadequate, resulting in not being able to do what the teacher envisioned. The outcome is that there is a possibility for learners to get wrong results and missing the point of the practice.

In the literature reviewed, Abrahams & Millar (2008) alerted that the teacher's lack of subject knowledge and learners' attitudes toward science are possible obstacles to effective use of practical work. Hodson (1990) further argues that unlike the common perceptions, learners' benefits are not improved by practical work. While Abrahams and Millar (2008) argue that most learners miss the mark to relate what they do in practical work to other facets of their knowledge and learning process. Explicit teaching could motivate learners to become inquisitive and to value science in general.

2.10.1 Quality of teaching

The role of the teacher is to plan practical work based on the pedagogical theory. According to Ayodele (2006) teachers inappropriate use of teaching methodology and lack of 'pedagogical knowledge' hinder learners understanding and achievement in Natural Science. The teaching and learning of Natural Science do not require theoretical lecture approaches only. Onose et al. (2009) state that many inexperienced teachers teach natural science in abstraction, thereby making science lessons boring and difficult for learners to grasp scientific concepts, skills and principles.

Most teachers' emphasis on the application of theory rather than the use of practical aspects of science subjects and most of Natural Science teachers lack adequate knowledge of subject matter and competence to deliver the subject adequately. In addition, they stressed that the teaching of

science has been reduced to a descriptive exercise through the use of lecture method and the use of inquiry provided little knowledge to students (Onose et al. 2009).

According to the Namibian Ministry of Education (2009), educators experience difficulties in terms of what and how to teach to instil knowledge into learners. Therefore, the way the teacher teaches needs to be improved in science education and in particular, practical activities.

When learners are well taught, they may be in a better position to use laboratory preparation to resolve their individual and social difficulties. Ary, Jacobs, Sorensen, and Razavieh (2009) indicate that learners are not suitably taught because of the lack of hands-on activities for practical work. Millar (2004) states that teaching and listening dominate science classes. Learners are engaged in written work and making summaries without doing any practical work. Teachers do not use a variety of teaching strategies to accomplish the anticipated purposes for quality practical lessons. For example, demonstrating projects, personalized work and instructional methods.

The application of knowledge of teaching and learning must be applied to accommodate learners' learning styles and replace theorizing in most class sessions to ensure hands-on activities. Practical activities involve taking learners out to explore, let them see and touch the apparatus, appliances and machines, record steps on field experiences and procedures (Ary, Jacobs, Sorensen & Razavieh 2009).

However, Mudau (2007) argue that inadequate provision of practical sessions within the school's timetable affects practical work. Therefore, there is a need for schools to schedule enough time for practical work to engage learners and to carry out practical activities in science.

Jokiranta (2014) explains that inappropriate time scheduling results in postponing lessons without learners finding closure of what they have devoted themselves for. There is a need for adequate time scheduling for practical teaching instead of the minimum provision of just 40 minutes each week. The Namibian Ministry of Education, Art and Culture need to expand the time sessions allocated for practical activities (Samaras 2002). In a knowledge-based society, it is important that the designers of the science curriculum reconsider the curriculum in its entirety and in terms of time schedule. Quality teaching and appropriate scheduling are important for practical work.

2.10.2 Quality teaching and learning resources

According to Abdulalu (2007), lack of resources for science teaching and learning in Namibia's schools has been a matter of concern. It is a well-known fact that the quality of education that a learner receives depends largely on the quality of teaching and learning resources provided by the school. Teaching and learning resources are used by the teacher during teaching to aid understanding and make teaching successful and effective for student learning. These resources include equipment, consumables, modern textbooks, like chemicals mixtures and reagents.

There is a lack of laboratories and books to support science teaching in Namibian schools. Omorogbe & Ewansih (2013) notes that learners need investigative skills such as observation, measurement, classification, recording, experimentation, analyzing and inferring skills. To achieve this, Natural Science classrooms, laboratories and the libraries must be adequate and conducive for learning. The inquiry focused on science teaching demands a lot of activities on the part of the learner that require scientific materials and equipment. Due to the fact that the majority of schools lack essential resources for imparting science knowledge and concepts, many learners learn little science. Learning tends to be by rote and therefore, many learners lose motivation and find science not interesting (Omoifo 2012).

Teacher-learner interactions in many science classrooms are not healthy because of the lack of adequate resources. In most Namibian schools, there are no facilities for the teachers to demonstrate their skills. Students rarely have hands-on, minds-on experiences. These circumstances pose a challenge in terms of preparation for science practical examinations. Most schools acquire science equipment for teaching demonstrations. Such an act advances learning and eventually results in better learning outcomes or achievement (Omoifo 2012). Ogunmade (2006) states that "the minority of learners do not have textbooks and most of the schools do not have public library facilities. In cases where these are available, the schoolbooks in the libraries are outdated. Lack of or inadequate resources and proper care of available resources remain a challenge in the Namibian education system. This case was also observed when the researcher visited the two schools even though it was not the researcher's main reason to observe the availability of textbooks. Learners and teachers can only do better in practical if they get exposed to enough theoretical information.

Factors contributing to quality practical teaching call for space adjustments to lodge all activities at different stages of teaching and learning as well as sufficient laboratory apparatus for all the learners. There is a scarcity of laboratory space, equipment, and cabinets in Namibian schools. With large teacher-learner ratio's science laboratory space has become a challenge. Basic biochemical substances for analysis and other apparatus are insufficient and, in some cases, are not available (Olaleye 2002). There is a need for the government to make funding available so that the basic biochemical mixtures could be obtained to provide for all learners within science classrooms. There is a need not only to improve the quality of science teaching and learning but to develop learners' scientific literacy to cope with the demands of science and technology through the use of practical work (McComas 2002).

Luft, Roehrig, and Patterson (2003) observe that the education system of Namibia has little learning resources a situation that hinders the quality of practical teaching. Many science teachers are skilled to teach science but the lack of resources limit and prevent them from transferring their skills to the benefit of learners. Reeves (2002) states that the laboratory as a teaching manoeuvre has been perceived as important by science teachers because of its usefulness in helping learners to learn. Therefore, the use of practical work in science teaching in Namibia is widely not on standard. It is accepted that good quality practical work encourages the engagement and interest of the learners as well as developing a range of skills, integrated knowledge and conceptual understanding.

Critique of laboratory work is also levelled as unproductive, confusing and without clearly thought-out purposes, unorganized and lack of resources (McComas 2002; Noah 2005; Lester 2003).

Keys (2003) reveals that teaching of practical work requires a humble place where practical activity enhancement can take place. However, many laboratory activities appear to have little impact on the way learners are supposed to learn to gain understanding and at the same time engage in processes to construct knowledge when doing science.

Significant learning of practical work can only be possible in a laboratory when learners are given enough opportunities to manipulate quality equipment and materials to construct knowledge of the occurrence and relate scientific concepts with their own experiences (Lester 2003).

Despite all suggestions, it is assumed that schools are not doing enough to engage learners in quality practical work with the available resources. Perhaps the most common reasons for this argument is that some teachers do not know how to use the science materials in case resourceful materials are not available in large quantities, thus sharing of learning materials has also posed a challenge of the teaching and learning of practical work (Treagust 2002).

Quality learning resources for practical work is an integral part of any science laboratory session. It makes scientific calculations alive and allows learners to perceive, aroma, taste or touch (Olaleye 2002). For science education to embrace a new perspective which may lead to the development of individuals that could be employable in the industry.

es, these challenges that prevent quality practical teaching must be addressed with urgency and seriousness (McComas 2002).

Namibia can only enjoy the fruit of development if it is science and technologically resilient. Therefore, science education determines the achievement of development by conveying necessary theories and practical skills that are central to the production of learners who can be competent in the industry (Ogunmade 2006).

Keys (2003) states that for a country such as Namibia to be sovereign it may depend on the scientific skills of citizens especially if practical skills are passed on from generation to generation. This skills transfer is possible when quality practical instruction is practised. Quality teaching and learning can promote knowledge transfer and may be a solution for science and innovation in Namibia.

This review of the literature identified and critique the lack of availability of teaching and learning resources that has become a necessity for practical work in science education. It is the responsibilities of educators to ensure how to apply learning resources in a way that learners can gain knowledge of enquiry when learning science concepts and education (Treagust 2002).

2.10.3 Lack of practical activities

According to Sitole (2016), the use of practical activities in most classrooms cause confusion and are unproductive for learners. George (2006) points to the fact that laboratory methods used, practical activities and the nature of learner's interaction in practical work are still far from being understood by learners. A similar concern was raised by Abrahams and Millar (2008) who argue

that many children, the activities, and what happened in the laboratory often contributes little to their learning of science. These studies (Ogunmade 2006; Hattingh 2004 & Nakedi 2014) ascertain that the use of practical work in many schools is unproductive and learners do not benefit from it as intended by their teachers.

Sitole (2016) further points out that natural science teachers lack expertise in using practical work effectively in their classrooms. The argument of Ogunmade (2006) reveals that natural science teaches learners about practical work and may not reflect the learner's actual practice in classrooms. The consequence of not using practical work effectively and as intended in the syllabus is that most learners may fail to relate what they do in practical work to other aspects of their learning (Abrahams & Millar 2008). Science teaching is especially inappropriate when teaching prohibit learners from reflecting on what they have learned.

Abrahams (2011) states that the underachievement of learners in science education may be the result of the inappropriate ways in which science practical activities are designed and taught in school. The “chalk and talk” technique dominates and is often used for teaching science (Lester 2003).

The Namibian Ministry of Education (2008) reveals that there is an earnestly for the discovery of practical skills in natural science in the Namibia schools which can hardly be measured at by natural science teachers. The target is always the outcome rather than exposing learners to tasks to perceive them, and demonstrate their practical skills (Moll 2002).

In schools, practical activities could be carried out in many ways. For some groups, work is not perceived as any practical lesson after the teaching of the subject, and accompanying lessons with experiments is a challenge (McComas 2002). Although many studies show that learners of science in Namibia perform poorly at all levels of education, it is also revealed that science subjects are coarsely performed. The main reason cited remained a perennial problem of the whole Namibia education system (Mudau & Tabane 2015; Namibian Ministry of Education 2008; Moll 2002).

Natural Science teachers are of the belief that learners can do group work to demonstrate the perceptions which are not consistent with an inquiry-oriented and constructivist approach in which learners engage during practical investigations to provide experiences from which understanding of concepts are developed (Lester 2003).

Consequently, Abrahams (2011) indicates that under ideal circumstances, practical activities does not encourage the way learners should learn natural science. Teachers should encourage learners to ask questions and express their ideas of science so that they can communicate findings that relate to real life rather than the science activities. In most instances, learners' responses are theoretical and lack real-life situations which makes it difficult for the learners to relate science beyond the textbook.

Cargan (2007) argues that learners are supposed to formulate their own problems of inquiry to investigate the world around them. Active engagement in the scientific inquiry may develop learners' broad knowledge and understanding of the processes and nature of science through open inquiry. Yet these activities are underdeveloped and not aligned with practical laboratory work which is the result of not accomplishing what it sets out to do in terms of science teaching and learning.

Nghipandulwa (2011) further documents that teachers' approaches toward practical activities are limited and do not portray the way scientific knowledge should be acquired. There might be methods and alternative ways to consider when entering a science inquiry discourse. Further, Luft, Roehrig and Patterson (2003) contend that learners do not simply learn what they are taught but learn from their prior knowledge, construct new knowledge and understandings and find regularity about world events and information in science. This is why effective learning of science could only be achieved by doing science through developing, constructing, and accommodating meaning in a context that builds on learners' prior knowledge and experiences (Olaleye 2002).

2.10.4 Teachers perceptions of the use of practical work

According to Ogunmade (2006), teachers perceive Natural Science as difficult and challenging, and therefore they show adverse attitudes. Many educators affirm that teachers' attitudes are often translated into their classroom instructional practice which has an effect on how learners perform.

Reeves (2002) indicates that the way teachers behave during their lessons is shaped and reinforced through personal values, formal teacher training, teaching experience and family upbringing. Therefore, it is expedient to consider teachers' beliefs in the teaching reform process by providing professional learning opportunities to influence teachers' beliefs and to achieve effective implementation of practical work in natural science.

A better understanding of teachers' attitudes is crucial to shaping the curriculum, providing guidance for educational leaders to sustain effective change, and for offering professional learning that may help teachers to reconcile their initial beliefs with that of the intended curriculum (Feldman & Minstrell 2000; Keys 2003).

A number of studies into teachers' attitudes in science teaching and learning have identified teachers' epistemological beliefs that include core and peripheral beliefs (Brownlee, Boulton-Lewis & Purdie 2002). Core beliefs involve beliefs about knowing that reflect a person's beliefs about what knowledge is, how knowledge is gained, its degree of certainty, and the limits and criteria for determining it (Brownlee et al. 2002).

On the other hand, peripheral beliefs are beliefs that relate to individual learning. These include learning strategies, motivation, influences on learning and conceptions of learning outcomes (Feldman & Minstrell 2000). Peripheral beliefs involve learners' conceptions of learning, their approaches to learning and their learning outcomes (Briggs & Coleman 2007).

Keys (2003) further categorized teachers' attitudes into contextual or environmental beliefs, expressed beliefs and entrenched beliefs. Keys (2003) defines contextual beliefs as those beliefs through which teachers perceive their ability to carry out or implement a certain teaching approach, curriculum tasks or initiatives that are dependent on certain environmental factors such as the need for enough teaching time, adequate curriculum resources and equipment, and the opportunity for professional learning among others. Keys (2003) further entrenches that beliefs determine actions or practice. However, such beliefs include teachers having regular inquiry-based practical and activity work for students because they believe it improves students' inquiry skills.

Keys (2003) emphasises that entrenched beliefs are reinforced over time as a result of the teacher's experience which validates his or her beliefs. Expressed beliefs are sets of beliefs that teachers espouse. However, teachers' beliefs are not enacted in practice because of their unwillingness to make changes or certain sacrifices.

A typical example is that "an accomplished teacher is someone who participates in ongoing professional learning or someone who engages the learners in a lot of hands-on inquiry and practical activity work." To the contrary, the teacher does not demonstrate the expressed skills or views within his/her practice (Keys 2003). This gap has been identified within the literature and the Namibia education system. There is a need to determine the effectiveness of professional learning opportunities to design an alternative strategy that could impact teaching and learning, especially in science.

According to Olaleye (2002), the teaching of Natural Science has become less important compared to other subjects. Reasons cited include low levels of motivation toward the field of science. Teachers show their negative perceptions and attitudes of science during classroom practice (Andrews 2012). These attitudes are conveyed to learners, which is the result of learners developing less trust and confidence in themselves and the teachers of science. Treagust (2002) states that science teachers' attitude toward Natural Science is supposed to be positive in order to encourage and motivate learners to have interest and effort in science.

Mudau and Tabane (2015) argue that if a teacher does not trust learners to perform better, learners' interest in learning a particular subject may be low. Luft, Roehrig & Patterson (2003) point out that teachers teach from the textbook instead of teaching from the heart. This implies that in most cases teachers highlight procedures when doing practical tasks instead of focusing on the outcomes of the task.

2.10. 5 Teachers' attitudes and knowledge

Lester (2003) finds that teachers who stress the importance of practical work in their classrooms, give more emphasis to the objectives of why they teach science in order to enhance scientific inquiry which is regarded an important aspect of science.

Mudau and Tabane (2015) believe that quality teaching of natural science requires qualified, knowledgeable and enthusiastic teachers with suitable subject matter knowledge and operational teaching skills. In a further review of the literature, McComas (2002) indicates that schools do not have enough qualified, knowledgeable, skilled, and enthusiastic science teachers. Teachers rarely have opportunities for proficient development and cooperation with other colleagues to improve their teaching skills.

Consequently, Dillon (2010) believes that many teachers do not show enough enthusiasm to develop learners' interest in Natural Science. In-service teachers are not provided with adequate professional development training or an induction programme to understand the school environment including colleagues, learners, the school community, and the school administration. There is no regulation of admission into the teaching profession, and this has an adverse consequence on the quality of science education in Namibia.

2.11. Coping strategies for science teachers

Research is needed to understand teachers' attitudes toward practical work, especially when teachers spend limited lesson time doing practical work during science lessons. There is a need to understand why teachers portray negative attitudes in an effort to benefit and enhance learners' engagement and enjoyment of science. In order to improve the quality of practical work in Natural Science, all teachers, students and other stakeholders of science in schools need to come together to share their strengths and shortcoming of using practical work (Ogunmade 2006).

According to Treagust (2002), the science curriculum content should be reduced and be relevant to the needs and aspirations of the learners and their real-life physical environment to learners to develop scientific knowledge of the enquiry. The author also indicates that there should be more time allocated to natural science lessons in the school timetable schedule in order for teachers to do more hands-on inquiry-based practical and activity work with learners.

Learners should be engaged in inquiry-based and hands-on practical activity work every week, practical lessons that relate science to students' real life, practical activities that stimulate thinking

about real-life situations in terms of Natural Science, regular interaction between teachers and learners, and monitoring or assessment strategies and feedback of student learning (Millar, Leach, & Osborne 2002). These changes may only be possible with more science teaching time accompanied by science practical activities, reduced class sizes, and enhanced teacher knowledge and skills.

Treagust (2002) states that teachers and students alike must develop the ability to engage in a discourse of science inquiry by using the language of the environment to improve learners' communication skills in science. Treagust (2002) notes that there should be adequate funding for science to build classrooms with enough seating arrangement for learners, laboratories with facilities and equipment, curriculum resources including modern textbooks and provision of laboratory consumables such as chemicals - potassium, magnesium and calcium phosphates.

Natural Science teachers require adequate support from school administrators, colleagues, parents, and community. Teachers should be provided with adequate opportunities for ongoing professional development activities and collaboration with colleagues and experts on curriculum materials and policy (Treagust 2002). As a result, teachers would be in a better position to improve teaching practice.

Quality teaching and learning of science in Namibia require a reduction of the science curriculum content. This content should be relevant to the needs and aspirations of the learners and their real-life physical environment to advance scientific literacy (Lester 2003). Nghipandulwa (2011) promotes consistent interaction between science teachers and learners, as well as to monitor the progress of learners through appropriate assessment strategies and feedback of learning (Abrahams 2011).

Kapenda, Kandjeo-Marenga, and Kasanda (2002) support the idea that the changes in doing practical work will only be possible with more science instruction time, concentrated class sizes, and enhanced teacher knowledge and skills are possible.

Also, teacher beliefs toward the subject that they are teaching and learners alike must develop the ability to participate in a discourse of science inquiry by using the language of the environment to improve learners' communication skills in science (Bennett 2005).

2.12 Assessments of learners

Strengthening teachers' assessment skills are paramount for practical work. Explicit teaching and assessment go hand-in-hand e.g. process skills, practical abilities and communicative abilities. Dlamini (2008) ascertains that understanding science requires an understanding of practical evidence and therefore the assessment of learners requires teachers to consider the evidence that the learners present after a given practical task. It is argued that practical work as a teaching strategy can be used to teach about ideas of scientific evidence. Practical work plays a key role in ensuring that the purpose of the task is clearly specified (Jokiranta 2014). Daniels (2004) argues that developing experimental skills in practical work can be approached best by recognizing that it is underpinned by a unique knowledge base which is different from functional knowledge and is linked to an understanding of logical evidence.

For Ramnarain (2011) this knowledge base of concepts of evidence had been excluded in most science curricula, leading to a gap that causes science teachers' confusion about the role and purpose of practical work.

McComas (2002) points out that in a practical task, there is a need to evaluate the validity of evidence of learners, however, one needs to take into consideration the design, data manipulation and measurements which are part of that evidence. In their study, Onose, Okogun and Richard (2009) contend that learners' overall performance during practical tasks is determined by their understanding of the importance of empirical evidence and its use in drawing conclusions. The evidence is crucial in that it enables one to understand and appreciate science and its contributions to crucial debates in society (Onose, Okogun & Richard 2009). While Ngema (2011) suggests that it is of importance for teachers to promote the assessment need for their learners and to provide evidence when they engage in practical activities and during classroom discussions.

It is important for teachers to note that 'good' results that are obtained during practical work do not necessarily indicate good practical skills from learners but learners can get 'good' results by

merely following teacher's instructions. Integration of these critical aspects in the assessment of practical work can ensure successful and meaningful use of practical work in schools (Maselwa & Ngcoza 2003).

Quality instruction is improved with regular intensive care of learners' learning outcomes (Murphy & Beggs 2003). In a review, Maselwa and Ngcoza (2003) indicate that learners are assessed for understanding of science content, and science skills and only a few teachers try to assess learners for science attitudes.

Among many teachers, written tests and quizzes are the most commonly employed assessment strategies used by science teachers followed by assignments and projects. Practical work and practice tests are the least frequently used assessment approaches. It is commonly known that science teachers do these assessments for grading and reporting only and they do not concentrate on seeing whether learners have understood the work or not (Maselwa & Ngcoza 2003).

According to the Namibian Ministry of Education (2008), continuous assessment is used by Natural Science teachers to determine learners' learning results opposed to entirely evaluating the assessment of learners' work and examinations on performance in practical work which is less encouraged for assessment. Treagust (2002) argues that assessment serves various purposes that include monitoring of national principles; comparing standards of achievement with those of other regions; providing information to hold teachers, educational administrators and politicians accountable to the public; to sort and classify students for education and training as well as for career placement by employers.

Practical work needs to be central to natural science learners in order to determine the direction a learner takes through the differentiated curricula. For the purpose of improving the understanding of practical work, quality assessment is supposed to encompass monitoring of learners' learning outcomes to identify learning weaknesses and strengths and to promote scientific knowledge of enquiry as well as to motivate learners to do science subjects (Corbin & Strauss 2008).

2.13 Improve the quality of teaching

The underperformance of science teachers in terms of adequate knowledge base and pedagogic skills need to be improved because it influences students' performance. According to Dahar and Faizer (2011) the teacher's academic qualifications and knowledge of subject matter, competencies and skills, and the commitment of the teacher have an impact on the teaching-learning process. A science teacher is anyone who teaches science. It is therefore of vital importance that teachers' knowledge and skills of practical activities should be upgraded.

Science teachers in Namibia should be prepared to teach verifiable scientific knowledge, using adequate pedagogy which can advance and lead to the achievement of goals for science education. Science education requires highly scientific and science literate teachers whose teaching approaches do not just emphasize theoretical perspectives but teachers whose teaching is influenced by real-life situations of science (Dahar & Faizer 2011).

Similarly, Okureme (2003) posits that an effective science teacher should be a master of his subject, and his pedagogy grounded in methods of teaching that enables him to relate science concepts to real life experiences. A knowledgeable teacher may combine science concepts, principles, theories and processes of science and familiarize himself with more complex relationships between science, technology and society. These teachers develop an understanding of the nature of science, reflect and make meaning of processes and accept learners individual learning styles and appreciate individual competence. This is important because the portion of scientific knowledge science teachers should choose to teach must direct the way learners learn (Omoifo 2012).

The teacher's knowledge base for effective science teaching plays an important role. Teachers guide learners to understand the content and underlying philosophy of science. Professional development of science teachers may contribute toward the production of scientifically literate teachers that can promote learners' achievement and attainment of the overall subject goals. In addition, there should be an adequate subsidy for science departments across the country to build more classrooms equipped with laboratory equipment and facilities, curriculum resources, including up-to-date textbooks and the provision of laboratory chemicals (McComas 2002).

Jokiranta (2014) reveals that science teachers should be trained on how to work with laboratory equipment and the education ministry should make provision for laboratory technicians, good maintenance of laboratory facilities and equipment as well as manageable class sizes so that teachers could be able to provide more inquiry-based and hands-on practical and activity work for students.

Furthermore, quality teachers are not easy to find. Therefore, improved teachers' welfare such as the payment of adequate salaries and allowances, systematic payment of teachers' salaries and allowances, more incentives and scholarships for teachers for further education, and improved recognition and value for science teaching and teachers by the larger communities than the majority of teachers may attract a skilled workforce to teach science (Dlamini 2008).

Quality teachers went through quality teacher training experiences, especially during their internship in teacher education. During this practice, teacher training ensures that teachers are competent, motivated and dedicated to science teaching and the teaching profession (Millar 2004). Failure to produce quality teachers needs a relook into teacher training. At the school level, school leadership plays a vital role in supporting teachers. Reeves (2002) stresses that Natural Science teachers should be adequately supported by the principals, colleagues, parents, the school community, and parents. Sufficient opportunities should be provided to engage both teachers and learners in science events.

Science teachers need to connect and network with other teachers who are in the teaching profession to collaborate with colleagues and experts on curriculum development, provision of materials and policy implementation to improve in an effort to enhance the teaching of practical work in science subjects (Garrett 2010).

2.14 Stakeholder engagement

In general, local government education offices, school principals and directors of education need to work hand in hand to maintain and provide laboratory facilities, ensure the commitment of science teachers to fully use efforts to encourage learners to practice, motivate learners, implement practical activities in schools and promote science in the region (Beyessa 2014).

Namibian Ministry of Education, Art and Culture have initiated a science education project that focuses on the establishment of school laboratories as well as to enhance knowledge and skills of science teachers (Negassa 2014). It is suggested that a promotional awareness on the importance of science education involving role model professionals, education organizations and well-performing science learners and science teachers may support the practice. Urevbu (2001) expresses concern that not all practical work specifications in the curricula assess learners' ability to plan scientific investigations. Therefore, demanding assessment practices are problematic for some science teachers.

For example, students may be asked to 'plan' an investigation similar to an experiment that they have carried out. The open understanding of the planning process could be assessed. The solution might be to ask questions for which there are no answers but which are still scientific (Okureme 2003).

Science teachers who have adopted 21st Century science assessments, often feel strongly that they do not want to do tasks set by the regional office as part of their assessment procedures because these assessments lack supportive materials. By doing it will lead to learners not able to understand the experiments (Samaras 2002). Likewise, teachers who have opted for personal assessments are not always enthusiastic about the requirements to undertake case studies with the implication of marking and access to activities (Sandoval 2003).

Science teachers should have the freedom to use assessed practical tasks at any appropriate point during their courses (UNESCO 2000). Assessing practical skills using a written paper can be seen to be incompatible and may lead to senior supervisors wanting to 'do' all controlled assessment in a separate week, decoupling them from the rest of the course. Although personal assessment of teachers was the best to help learners improve in science, according to Treagust (2002) the benefit of that assessments should take place in school as it removed the problems of students receiving parental help.

It is important that practical work continued to be assessed as part of the Natural Science practical activities. It is key to ensure that assessing practical work remains an important part of the curriculum. The pressure of career sciences and other science bodies can mean that work that is assessed is prioritized (Abrahams 2011).

To ensure that practical work remained at the heart of the science curriculum, teachers must continue to assess the learners and ensure that learners meet the minimum requirements of understanding science content (Owen, Dickson, Stanisstreet, & Boyes 2008). Okhiku (2005) ascertain that all science stakeholders are central to education, but they must not be placed in the position of being solely responsible for reform. Educators will need to work within a collegial, organizational, and policy context that is supportive of good science teaching. In addition, all stakeholders of education must accept and share responsibility for the pupils learning.

In view of science education, there is a need to promote effective teachers of science who can create an environment in which both teachers and learners can work together as active learners. While learners are engaged in learning about the natural world and the scientific principles needed to understand it, teachers should also work with their colleagues to expand their knowledge about science teaching (Okureme 2003).

To teach science, teachers should work to collaborate with other experienced teachers especially those who have the combination of theoretical and practical knowledge and abilities about science, learning, and science teaching (Omayuli & Omayuli 2009).

The education system must also act to sustain effective teaching in science by explaining the science curriculum, expectations of the science education, endorse the vision of science teaching to make it easy for teachers to understand what is expected from them (Omoifo 2012).

The emphasis should not only be given to how teachers should deliver the curriculum but the science teachers must be provided with resources, time, and opportunities to make the necessary change as described in the curriculum documents. All stakeholders must work within a framework that encourages every teachers' efforts and commitments (Onose, Okogun & Richard 2009).

Urevbu (2001) argues that the changes required in the educational system to support quality science teaching are important. Nonetheless, changes in teaching must begin before all of the systemic problems are solved so that teachers who are the implementers of the curriculum are geared toward that implementation.

Over the years, educators have developed many teaching and learning models relevant to classroom science teaching, however, little has been provided on how practical work should be

advanced to such a level where every learner has become the centre of learning science (Onose, Okogun & Richard 2009).

It is of paramount interest for all stakeholders to provide feedback about the strengths and weaknesses of these models of teaching practical work, so that teachers can examine the relationship between the science content and how that content is to be taught. This will help the science teachers to integrate a sound model of teaching and learning, a practical structure for the sequence of activities, and the content to be learned by learners (Urevbu 2001).

Ary, Jacobs, Sorensen, and Razavieh (2009) note that inquiry into authentic questions generated from learners' experiences is the central strategy for teaching science. All the science teachers should come together and develop focus inquiry principally on real phenomena, in classrooms, outdoors, or in laboratory settings, where learners are given investigations or guided toward practical investigations that are demanding but within their capabilities.

It should be understood that learners cannot always return to basic phenomena for every conceptual understanding. Nevertheless, teachers can take an inquiry methodology as they guide pupils in acquiring and construing information from sources such as libraries, government documents, and computer databases or as they gather information from experts from industry, the community, and government (Onose, Okogun & Richard 2009).

2.15 Conclusion

In Chapter 2 the literature reviewed covers the definition of practical work, the nature of practical work, types, purpose, and role of practical work in science teaching. Inquiry-based teaching and learning is at the heart of science teaching and emphasized learners' responsibility to discover new knowledge. The study is situated within the socio-cultural theory of Vygotsky and the social constructivist theory of Piaget. This chapter also outlined the factors limiting Natural Science teachers to engage in practical work as well as their perception toward the use of practical work. In conclusion, measures for both science teachers and other stakeholders in schools' departments or the community at large are suggested for implementation to help the science teachers to cope with the challenges that arise with teaching practical work in Natural Science. The next chapter discusses the research methodology and research design of the study respectively.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter outlines the research design and methodology of the study. This study uses a qualitative case study design. Yin (2009: 81) states that “qualitative case studies aim to understand the phenomena from the perspective of the participants in the case” Case studies aim at exploring a certain phenomenon or issue in depth. According to Baxter and Jack (2008), the case study method is helpful when studying science, developing theories and when evaluating programs, if the method is applied rightly. Furthermore, case study research is characterized as an approach “that facilitates exploration of a phenomenon within its context using a variety of data sources” (Baxter & Jack, 2008:544). As case study data may come from a variety of sources, case studies are often, but not necessarily, based on different methods (mixed methods) and, as a consequence, different data sources. Yin (2012: 10) lists the following six common data sources: “direct observations, interviews, archival records, documents, participant observation, and physical artefacts.”

The study used interviews and observations as data collection methods to understand the limiting factors of practical work in Grade 7 science teaching and learning. The practice of relying on multiple methods of data collection is commonly called triangulation. Triangulation helps to ensure the validity and reliability of qualitative research findings. Data triangulation refers simply to using several data sources, the obvious example being the inclusion of more than one individual as a source of data (Guba et al. 1980). The benefits of triangulation include increased confidence in research data, creating innovative ways of understanding a problem, thus providing a better understanding of the phenomenon (Thurmond 2001). The following question guides the study:

What are the factors limiting Natural Science, Grade 7 teachers from engaging learners in practical work?

In the next discussion, an outline of the research design is given.

3.2 Research design

This study is a case study because it includes individuals, education institutions, processes, and a program which align with the features of a case study according to Yin (2009). Qualitative case studies as a form of qualitative research, share with other forms of qualitative research the search for meaning and understanding, the researcher as the primary instrument of data collection and analysis, an inductive investigative strategy, and the end product being richly descriptive (Merriam, 2009). On the other hand, Yin (2009) states that case study's unique strength is its ability to deal with a full variety of evidence- documents, artefacts, interviews, and observations – beyond what might be available in a conventional historical study.

Patton (2010) believes that a research design can be an implementation method of the research which comprises of steps and explanations of how data would be analyzed, interpreted and presented. Therefore, a qualitative research design was selected for this study to outline all strategies involved in answering the research objectives and to make conclusions on practical work. This case comprises of two schools in the Ogongo circuit of Omasati region.

3.2.1 Research setting

The research was conducted at two schools. There are 21 teachers and 550 learners at School A, and 14 teachers and 360 learners at School B. Both teachers and learners were interviewed during school hours in a classroom. These schools are located in small villages in the Omasati region.

3.2.2 Research paradigm

Fraenkel and Hyun, (2012) define research paradigm as “a study that investigates the quality of relationships, activities, situations, or materials.” On the other hand, Corbin and Strauss (2008) state that qualitative research (paradigm) produces findings not arrived at by means of statistical procedures but rather a systematic, interactive and subjective approach used to describe life experiences and give them meaning. Cresswell (2008) defines qualitative research as a type of educational research in which researchers rely on the views of participants. Creswell (2008) argues that qualitative research brings civic responsibility that is needed for change in the society, therefore the study builds on this strength to bring changes for Namibian science educators in terms of practical work.

Therefore, this study sought to investigate the factors contributing to poor practical work in Grade 7 context. The study is carried out by collecting data from interviews and observations which

demonstrate knowledge that teachers can apply to improve their skills of practical work in schools. The study also collects data on how teachers apply inquiry-based teaching to promote student learning.

The phenomenon under investigation is teaching and learning of practical work. Through interpretative inquiry, the researcher gained a rich understanding of how practical work can affect learners and teachers as well as to determine mechanisms that could be used to improve the teaching and learning of practical work in Natural Science Grade 7.

Interpretivism also put to perspectives, interesting theories which may help to explain the realization of practical work in a practical way. In this case, interpretivism remains a podium through which the reality of teachers and learners experience is involved in practical work (Cresswell 2008).

3.2.3 Research approach

This study uses a qualitative research methodology and selected a case study engaging selected schools in the Omusati region. The reason why the researcher has chosen this approach was to explore the factors that impede the practical work of Natural Science teachers and learners in Grade 7.

Qualitative research refers to comments and depths that can be made subjective and repeated by other researchers. This approach study human behaviour within the social world (Patton 2010).

This approach was appropriate for this study because it allowed the researcher to find synergy among respondents, as they built on each other's comments and ideas. Qualitative research is designed to reveal a target audiences' range of behaviour and the perceptions that drive these behaviours with reference to specific topics or issues. It used in-depth studies of small groups of people to guide and support the construction of such behaviour. Using this approach enabled the researcher to get to the root causes of poor practical work in Natural Science, Grade 7 while interacting with the participants.

The researcher developed subjective meanings of their experiences, directed toward certain objects or things. These meanings are varied and multiple, leading the researcher to look for the complexity of views rather than narrowing meanings into a few categories or ideas. The goal of

the research is to rely as much as possible on the participants' views of the situation being studied (Best & Khan, 2006).

This design helped the researcher to use semi-structured interviews so that the participants could share their views about their perceptions of practical work, which in this case helped the researcher to interpret what he found imperative to shape the researcher's own experiences and background (Creswell, 2006).

The researcher employed a case study approach that has examined the experiences of educators with regard to the factors contributing to practical work in Natural Science among teachers and learners in Grade 7 of the selected schools in the Omusati region.

Factors affecting the experiences of Natural Science teachers and learners in practical work in Grade 7 might be beneficial and of vital importance to the learning process and would form the basis to explore how educators apply their teaching methodology when teaching practical work to improve the learners' understanding. This study also explores the mechanisms /strategies that teachers could put in place to improve teaching science subjects. In addition, the study also allowed for open-ended questions making it possible for the researcher to interact with respondents in order to generate in-depth answers.

3.3 Research methodology

This section discusses the methods used to arrive at the findings and conclusion of the study. This section highlights the demographic profile of the participating schools, explains the data collection methods, sampling, the data analysis and the validity and reliability of the study.

Table 3.1: *Data collection settings and instruments*

Dates	Education Region	Research sites	Data collection
12 March 2018	Ogongo	circuit School A	Interviews
20 March 2018	Omusati Region	School B	Observations

3.3.1 Selection of setting and research participants

The study used purposeful sampling to select the participants of the study. Purposeful sampling allows the researchers to “actively select the most productive sample to answer the research question” (Marshall, 1996: 523). The population of the study includes Grade 7 teachers and learners of the selected schools. The study selected the sample from a population that comprised two units. Sampling is the process of selecting units from a population of interest so that the findings may fairly be generalized based on the results from which population was chosen (Boudah 2011). The criteria for the selection of the sample were 1) Grade 7 science teachers, 2) at least three years of experience of teaching science in Grade 7.

Purposive sampling is when a researcher focusses on particular characteristics of a population that was of interest, which best enabled the researcher to answer the research questions (Blumer cited by Patton 2010). According to Creswell (2002), purposeful sampling is a technique used to select a sample with a specific purpose in mind.

In this study, the researcher favoured purposive sampling because it allowed for the selection of the participants based on the decision about which participants would be the most useful or representative for the study. Three Grade 7 Natural Science teachers and four learners from two schools in the Ogongo circuit of the Omusati region were selected as the participants of this study. The participants’ informed consent was sought before participating in the study, and they had the opportunity to decline participation to any or all questions during an interview and in the questionnaire. Pseudonyms were used throughout the research paper to protect the identity of the participants, and any other identifying information such as the names of schools is withheld in this report.

3.3.2 Research instruments

Semi-structured interviews, observations and document analysis were used to collect data. The use of these three instruments allowed for a rich wealth of data to be generated.

i) Semi-structured interviews

McMillan and Schumacher (2006) described semi-structured interviews as questions that are organized around areas of particular interest, while still allowing considerable flexibility in scope and depth. In the semi-structured interview questionnaire, the first 10 questions focused on how Natural Science teachers teach science without engaging learners in practical work. Moreover, the

semi-structured interview has allowed Natural Science teachers to recognize the importance of practical work and enabled teachers to explain critical issues affecting practical work during teaching. In a follow-up, teachers were probed on pedagogical activities. All interviews were audio-taped with the permission of the participants. Both teachers and learners were interviewed (See **Appendix 2**: Interview questionnaire).

ii) Classroom observations

Observations lead to a deeper understanding than an interview alone because it provides knowledge of the context in which an event occurs and enable the researcher to see things of which the participants themselves are not aware of that they are unwilling to discuss (Patton, 1990).

Robson as cited in Cohen et al. (2007:396) notes that “what people do may differ from what they say they do”. They also note that observation enables a researcher “to look at everyday activities and behaviour that otherwise might be taken for granted or go unnoticed” (Cohen et al 2007: 398).

Three lessons from each of the three teachers were observed and video recorded. The observation sought to find out what are the factors limiting Grade 7 Natural Science teachers from engaging learners in practical work.

iii) Document analysis

Secondary data comprised of documented sources such as the science syllabus and curriculum. Document analysis is a form of qualitative research in which documents are interpreted by the researcher to give voice and meaning on a specific topic. The authenticity and nature of documents will be defined and noted in the analysis. Analysing the content of documents incorporates coding content into descriptive categories and themes, a process similar to how interview transcripts are analysed.

3.3.3 Data collection procedure

The researcher has first sought permission from the Omusati region education director to access schools and requested teachers’ consent for participation in the study. Letters were sent from the Omusati education director’s office to the principals of the three schools to seek permission to do the research at the selected schools and to seek the participants’ consent and approval to participate

in the study. The researcher has also explained the purpose of the study to the participants and discussed the ethical issues with the participants.

3.3.4 Data analysis

Thematic analysis was used to analyse the data (Braun & Clarke 2006). Patton (1990) states that interpretive research tends to use qualitative research to see how themes emerge from the data generated. McMillan and Schumacher (2010) state that qualitative data analysis in most cases uses an inductive process to organize the data into categories and identify patterns according to different themes.

Cohen et al. (2007) describe qualitative data analysis as a systematic process of coding, categorizing, and interpreting data. Thematic analysis was suitable for this study because, it involved reduced accumulated data to a manageable size, developing summaries, and looking for patterns. Coding was used from the beginning of data generation to break down the data into manageable pieces. All themes that emerged from interviews, observations and documents were used to help the researcher in answering the research question about the teachers' use and perceptions of the importance of practical work and the challenges teachers faced in teaching practical work in Natural Science.

3.3.5 Validity and trustworthiness

According to Bassey (1999: 75), "validity is the extent to which a research fact or finding is what it is claimed to be." To ensure the validity and trustworthiness of the study, a semi-structured interview and observation protocol are provided to validate whether questions asked are consistent with the study's main purpose.

Moreover, the use of multiple methods helped the researcher to triangulate and to build on each type of data collection while at the same time compensating for potential weaknesses in any single approach (Patton, 1990). Triangulation was used to complement and look for consistency, patterns and discontinuities in the data collected. This process ensured more valid and reliable data which made a diverse construction of realities of teachers' views and opinions of their teaching practices in practical work.

The study ensured that constructs presented by participants were accurate. The interpretation of interviews and observations relied on the participants' own words and concepts. As indicated earlier in the chapter, the audio-tape recorder was used to capture the data and reflect on what was interpreted. Interviews were audio-tape recorded and classroom observations were video recorded after obtaining permission from the participants and transcripts created a thick description of the data.

The study used to follow up discussions after observations and member checking of interview transcripts to share the interpretations with the teachers in order to corroborate the data. Reflexivity was considered throughout the research process, Bassey (1999) states that interpretive research requires researchers to be aware of the standpoint from which they conduct the research. Qualitative data could be descriptive and interpretive (heuristic).

The researcher was aware of the role of the participants within the research process. In order to guard against being bias, the study has examined any assumptions critically as potential threats to validity. The study has ensured that it does 'proved' a particular perspective or manipulate the data to arrive at predisposed truths (Patton 1990). The study understood the world as it is, "to be true to complexities and multiple perspectives as they emerged, and to be balanced in reporting both confirming and disconfirming evidence" (Patton, 1990:55).

3.3.6 Ethical considerations

McMillan and Schumacher (2010: 16) state that since educational research naturally involves humans as participants, researchers are required to protect the "rights of the participants" in the study. Therefore, letters were written beforehand to the participants and their school principals to get permissions for the study and to get their agreement as participants.

The study involved two Grade 7 Natural Science teachers in Ogongo circuit. Cavan (1977) cited by Cohen et al. 2007:58) define ethics "as a matter of principled sensitivity to the rights of others and that while the truth is good, respect for human dignity is better".

Bell (1993) argues that no researcher can demand access to an institution or materials. The participants were informed about the aim of the study and they had an opportunity to choose whether to participate in the study after being informed. The participants' identities were not be disclosed and the data generated from the research were kept confidential. Moreover, participants were informed that they were free to withdraw from the study at any time without any obligation. To further ensure anonymity of the participants the names of their schools were not revealed in the research.

No major risks were encountered in this study. Teachers and mostly learners experienced slight embarrassment/shyness as a result of being video recorded.

The research involves learners less than the age of 18 years which made them vulnerable. The vulnerability was reduced by requesting informed consent from the learners' parents and learners were given assent forms. Their confidentiality and anonymity were protected at all times.

Upon completion of this research, a copy of the thesis will be given to each one of the schools that took part in the research and a summary of the findings and recommendations will be discussed with the participating NSHE teachers and learners of the schools that took part in the research. The thesis would be available at Okahao community library.

3.4 Summary

This chapter focuses on the research design and methodology of the study. A qualitative case study guided the data collection process. Purposeful sampling directed the selection of the participants. The data was collected, using semi-structured interviews, classroom observations and document analysis. The next chapter discusses the data analysis and presentation.

CHAPTER 4

DATA ANALYSIS AND DISCUSSION

4.1 Introduction

The main purpose of this research is to investigate factors that contribute to the lack of practical work in Natural Science, Grade 7 in the Ogongo circuit of the Omusati region.

Participating Grade 7 teachers have different perspectives and in-depth views with regard to Natural Science practical work. Pseudonyms were used to discuss the data and to protect the anonymity of participants. I assigned codes to aspects of practical work, and started to construct categories from the data. Line numbers were added to each transcription in order to allow for ease in the data analysis process.

The analysis begins with a process of open coding as soon as the first interview was completed. Each interview was coded separately, and constantly compare the other codes. In a follow-up interview more data was collected. The “inductive” and “comparative” method of data analysis, based on the constant comparative method (Glaser and Strauss, 1967) as cited by Merriam (2009: 75) was used. The main purpose of this chapter is to analyse and present the findings of the study in relation with the research objective and main research questions. The question of the study is: What are the factors limiting Grade 7 Natural Science teachers from engaging learners in practical work?

4.2 Semi-structured interviews

Six Grade 7 Natural Science teachers and learners were interviewed. These participants involve two teachers and four learners. I used an interview protocol that comprises of ten (10) semi-structured interview questions and nine probing questions. These interviews were conducted in a quiet place in a classroom at the respective schools. I put the participants at ease by asking them to tell me more about themselves and whether they like teaching practical work.

The teacher responses were examined and open-coded with an explanation of each code and text examples provided. Interactional themes of clarification strategies included categories such as frequency of practical work, lack of time, lack of classroom facilities and materials, teaching strategies used, teachers’ training and classroom management. Table 4.1 outlines the participating teachers’ demographic information.

4.2.1 Teachers’ interviews

Table 4.1: Demographic information of teachers

Teachers	Age	Gender	Class size	Qualifications	Years of experience
Teacher X	30	Female	36	BETD	5
Teacher Y	25	Male	31	B. Ed	3

Table 4.1 presents the demographic information of the participating teachers obtained during teachers' interviews to collect the primary data for this study. One of the participants, Teacher X is 30 years old, while Teacher Y is 25 years old. The class size of both teachers exceeds 30 learners. Teacher X has more than 5 years of teaching experience while Teacher Y has less than 3 years of teaching experience.

The duration of the interviews was approximately 20-30 minutes long. The semi-structured interview protocol consisted of 10 open-ended questions that focused on key factors limiting teachers' science practice. The key question in the interview salient to this study focused on how or why respondents experience challenges when doing practical work during science lessons. Data was constantly compared and triangulated. Triangulation is a strategy to enhance the validity of findings. The analysis of the data shows the interplay between interviews, observations and document analysis. According to Merriam (2009), "the researcher is the primary instrument for data collection and analysis" in qualitative research studies (p. 160). This is one advantage of conducting qualitative research because it allows for more openness and flexibility during the data collection process. The researcher has transcribed the data from the audio-taped recordings and identified codes within the data.

In the analysis of interview transcriptions, the researcher identified recurring patterns inside the data to look for common codes that were relevant to the study and which align with the purpose of identifying factors that limit Natural Science teachers' teaching. For the initial coding purposes, the researcher went through each transcribed data set and chose a code using participants' word choice, a sentence or clause that align with the purpose of the study. For written texts, the utterance can be coded by sentence or by clauses within a sentence (Geisler 2004). The first codes that emerge from the interview data included: *practical work, frequency of practical work, time scheduled for practical work, classroom facilities and materials, teaching strategies, training and classroom management*. The verbatim excerpts from the participants were cited and revealed factors that limit science practical work in terms of time. The narratives of the participants are quoted and grounded in relevant literature to discuss the themes identified in the data analysis next.

4.2.1.1 Practical work during science lessons

The data presents teachers' perspectives of what practical work is within a Namibian context. The following views were solicited from the participating teachers on how learners are engaged in lessons when doing practical work:

Teacher Y responded in line with the topic 'states of matter' and according to the Natural Science Curriculum for Grade 7 as follows: "We do things like 'states of matter' in which the learners and I collect some materials to compare the characteristics of different states of matter."

In another assertion, Teacher Y revealed that "there are many activities I give regularly. I usually use the "question and answer method" or I send learners to go find information based on the teaching topics from their environment. For example, to bring different leaves of different shapes." From the data, it is evident that Teacher Y has an awareness of practical work. However, Teacher Y did not specify the topics or any depth of what he does during practical work to engage learners productively during practical work.

Another participant, Teacher X's view reveals that:

"For practical activities, I engage to specify living organisms under scientific processes. They do the measurements, the length and weight of different objects, and other simple tasks during practical lessons."

In a follow-up interview, I probed teachers deeper to find out what explicit activities they teach. The participating teacher responded as follows: "I teach learners to create something. For example, a model such as a solar cooker. Sometimes I also ask them to do investigations in the classroom. Recently, we planted a bean in a container and watched it grow. The learners recoded the changes over a period of two weeks. They described the process which was graded ultimately."

From the data, it emerges that Teacher Y provides some hands-on activities to engage learners in practical work. The narratives or experiences of Teacher Y lack in terms of what Teacher X did. Pedagogical knowledge and belief systems are shaped before teachers enter the classroom and during teacher training. In addition, one of the most important factors shaping teacher knowledge and growth is on-the-job training and experience (Oleson & Hora 2013). Teacher X gave indicators or how learners are engaged and noted an important skill such as recording information during practical work.

Participating teachers cited reasons for learners' inability to participate during practical work as:

"Most learners lack practical skills like the basic skills to conduct practical work. They also lack confidence, it means they are not confident enough to engage in practical work. They have a poor understanding of whether practical work is really important or not."

On the other hand, it was also revealed that "learners who are demotivated and do not follow instructions during practical work. When the theory is not clear... I mean if it is not well explained

to learners, learners can find practical work very complicated and as a result, they lose interest in doing practical work.” Teaching practical activities to rely on how the teacher has structured the teaching of content (Onose et al. 2009).

According to Vygotsky’s theory, for a learner to maintain control over their thoughts and actions they need to have the proper instruction and support to learn how to self-regulate. Failure to engage learners in active science activities may result in learners’ losing interest during practical activities.

4.2.1.2 Frequency of practical work

The participants revealed that practical work is not regularly presented during science lessons. In response,

“**Not so often**, ...probably I can say two to three times in two weeks depending on the specific topic for the lesson. Not really, this is the reason why some practical work goes un-conducted, not only because of that but also other specific circumstances. For some topics in the syllabus, practical work is not required.”

In another comment a participating teacher reveals: “Well, ... I actually have five lessons per week. These include three single lessons and one double lesson.” In a cross-check, using the National Curriculum for upper primary, the MEAC (2015) indicates that for Science, Grade 7, the timetable makes provision for 5 science sessions per week. These sessions include one double session. In line with the National Curriculum of Namibia, it seems that Teacher Y understands that double sessions are scheduled for practical work.

4.2.1.3 Lack of sufficient teaching time

Time poses a challenge to do a practical lesson in overcrowded classrooms and within the provision of 40 minutes for practical lessons. The following comment reveals the participants’ view of lack of time.

“Time for practical work is too little. 40 minutes are not enough to do theory and practical work. This situation makes you choose to do either theory or practical work.”

Teachers’ experience plays an important role in making teaching decisions within the classroom context. Teachers striving to change their pedagogy to include strategies that teach students about scientific inquiry through ill-structured classroom activities may lack knowledge of the processes involved. Collaborative inquiry involves the creation of a classroom learning environment that highlights new roles for teachers and students. These roles differ from the traditional roles of teacher as knowledge-giver and student as knowledge-receiver (Crawford, 2000). Such teacher-centered strategies are discouraged, especially for primary school learners who are in their formative years.

4.2.1.4 Teaching materials and equipment

To illustrate, pedagogical knowledge practices include the planning of lessons and preparation of resources that target learners' specific skills development when engaging learners in practical work. Participating teachers reveal that "equipment and apparatus for practical work are not adequate. You cannot perform some practical work with this equipment that are not available in for teaching." In another comment, a teacher reveals that "There are no laboratory equipment, you have to plan and improvise or use what is available. These are not always effective for use." Furthermore, it was revealed that "No, one can say there is almost no equipment and materials at our school." This implies that there is a lack of materials and equipment to advance student learning in science practical work.

4.2.1.5 Teaching strategies

During the interviews it became clear that teachers' teaching strategies are inherently teacher-centered. In the participants' comment,

"A practical lesson is a challenging lesson to plan. Trust me..... If 70 percent of the teachers across the country try to avoid practical lessons, it is simply because they do not know how to go about them."

Lack of knowledge and teaching methodology prevent teachers from presenting lessons that engage learners' inquiry-based teaching in Science. In the absence of knowledge and skills of teaching, teachers resort to how they were taught in schools.

The following comment reveals the participating teachers' perspectives about learning. "Practical activities are good reinforcers. A teacher can use them to reinforce specific subject content. Furthermore, practical activities can improve learners learning and comprehension of the subject since learners are given a good chance to experience the subject matter in real life. From the analysis, the following comment is also a testimony of how teachers see practical work:

"Practical activities are there to make learners understand better. Practical work provides ways on how a teacher can back up what she/he has explained to learners theoretically."

When a teacher presents active and engaging lessons, learners could benefit from science teaching. In a study, Crawford (2000) states that "every student must be interested and engaged in various tasks such as recording observations in notebooks; discussing their observations with other students, and retrieving materials from a back-office area store room" (p. 916). From the interview responses of the participating teacher, it is evident that there is a mismatch between what science teaching is supposed to offer and what is the reality of science teaching in Namibian science classrooms. Teaching strategies remain knowledge-driven and are not based on inquiry or experimentation.

4.2.1.6 Professional development and training

Teacher professional development should address the multiple forms of knowledge required for teaching and involves the development of effective knowledge management processes (Leask & Younie 2013). A participating teacher indicates- “I noticed that teachers use almost entirely the lecture method. Learners loose interest in these lessons and are left out of teaching. Learners have different learning styles for which teachers cannot cater within the teaching and learning process.”

Based on this assertion, there is a need for science teachers to be trained appropriately to use an inquiry approach to engage learners actively in scientific investigations that provide them with opportunities to explore possible solutions, explain phenomena, elaborate on potential outcomes, and evaluate findings (Duschl et al. 2007; Harris and Rooks 2010). Professional development for science teachers is required to allow them to learn up-to-date practices and how to use technology in science teaching.

4.2.1.7 Classroom management

Classroom management has diverse meaning to different teachers, irrespective of their level of expertise. For Teacher X it means,

“It is difficult to control the class during practical work because learners have to fetch apparatus and engage into discussions. There is just too much movement in the classroom. Their mood rises and they feel free.”

On the other hand, Teacher X feels – “No... in fact, classroom control is not a problem. It depends on the way in which teachers conduct practical work. If they do what they are supposed to do, it helps to control learners with behavioural problems because it doesn’t give them a room for concentrating on other business. It engages them and keeps them busy to do what must be done in class.”

The Namibian Ministry of Education (2015) indicates that classroom management means how teachers use teaching resources in the classroom like time, materials, activities, behaviour, and learners’ behaviour are only a few of the things that are managed. In some cases, this means establishing rules. In other cases, it means using discipline with learners (MEAC 2015). This definition of classroom management does not allow teachers to value learners interactive participation in lesson activities, especially during practical work as revealed in the comments of both teachers. Authoritarian teaching restrains learning. Strauss (2018) cited Paulo Freire (1991) which calls this a ‘banking’ model of education and exhorts educators to move to a more critical pedagogy that is transformative.

4.2.2 Learners' interviews

Table 4.2 presents the demographic profiles of learners. The learners comprise of 2 female and 2 male participants. All learners were in Grade 7.

Table 4.2: *Demographic profiles of learners*

No. of learners	Gender	Grade	School
2	1 female, 1 male	7	School A
2	1 female, 1 male	7	School B

In the analysis of learners' transcription data, the researcher looked at codes grouped under each concept to try and "discern the range of potential meanings contained within the words" (Corbin & Strauss 2008: 109). This process allowed for in-depth analysis of codes contained under each concept in order to begin to develop the properties and dimensions of each of the concepts. Table 4.3 presents the codes and concepts of learners' data analysis.

Table 4.3: *Concepts/Codes of learners' responses*

Item No	Responses	Codes/concepts
1	I understand that it is very important and crucial I understand the teaching of natural science that we should learn to pass and became Natural Science teachers. Natural science is for us so that we became scientists and teachers.	Interest in Science
2	Often We carry out practical once in a month We do practical once a month.	The frequency of practical work
3	Yes's because if there's nothing theory and conduct practical some of the majority no pass. No, because it is finishing the time of the period.	Time

4	<p>Is practical because I like practical.</p> <p>Yes... practical need to be conducted after the theory because they are fun and they will make you not to forget.</p> <p>Theory because the teacher tells you everything and you are quiet.</p>	<p>Valuing science</p> <p>Teaching strategies</p>
5	<p>In part because I am better in practice only and I do not understand the theory.</p> <p>Practical, because I don't use to feel sleeping in practical like I use to feel in theory</p> <p>In practical because it used to be like I am still seeing what we were doing</p> <p>In theory, because I was listening to the teacher very well.</p>	<p>Level of understanding</p> <p>Teacher-centred</p>
6	<p>Matter and electricity</p> <p>Separating water soluble and insoluble by decanting, filtering and distillation.</p> <p>We do what affects the rate of dissolving.</p> <p>Decanting, filtering and distillation.</p>	Interest in Science
7	<p>Yes, I think because if that day teachers come to practice the time will not be enough.</p> <p>Yes, because we are still doing our practical and the bell rings.</p> <p>No, we will not have enough time, that time is just fine.</p>	Time
8	<p>Practical is better for me.</p> <p>Our teacher doesn't like to give us practical, only teach.</p> <p>There is no enough space in the classroom for some practical work.</p> <p>Learners are not bringing what the teacher sent them.</p> <p>We always don't have enough time to finish practical work.</p>	<p>Teaching strategies</p> <p>Facilities</p> <p>Materials</p> <p>Time</p>

9	The teacher should give practical work which is short so that time will be enough	Time
	The government should buy for our school a lot of materials because these ones are not enough for us.	Materials
	The school should increase the practical hours	Time
	Our teachers need to give us more practical work	
	The school to give learners and teachers money to buy materials for practical.	
	Teachers should stop sending us materials. E.g. salt.	

The researcher used the learners' interview data to triangulate the primary data collected from teachers. The following concepts were identified: Interest in Science, the frequency of practical work, time, level of understanding, teaching strategies, materials and laboratory facilities,

4.2.2.1 Learners' interest in science

Because of the researcher's interest in the factors limiting Natural Science, Grade 7 practical work, learners' individual interest in the field of science was solicited. This concept triangulates with teachers' teaching strategy, and level of understanding. When teachers use diverse science teaching strategies such as technology-rich activities, it may motivate and stimulate learners' interest in Science. Teachers realized their shortcomings of teaching. In the participating teachers' comment, "Another factor is the integration of IT, for example, we use our school library, in our library we can use computers to search for information from the internet which I see helpful to my learners, so Information Technology (IT) also helps me to teach better." Learners level of understanding differs in terms of background experience, language, gender, interests, the speed of learning, support systems for learning, self-awareness as a learner, confidence as a learner, and several other factors. Training on how to integrate technology during practical work may offer a remedy to both teachers and learners' challenges toward teaching and learning and at the same time promote increased understanding of science concepts.

4.2.2.2 Frequency of practical work

One of the factors limiting science practical work, is time. Learners revealed that limited practical work is scheduled. Learners cited practical work once in a month.

4.2.2.3 Materials and laboratory facilities

Active learning engages students in the process of learning through activities and/or discussion in class, as opposed to passively listening to an expert. It emphasizes higher-order thinking and often involves group work, pair work, pair share, drawing a diagram etc. In the analysis of the results,

learners requested “The school management to budget appropriately to buy materials for practical work.” Also, “teachers should stop requesting learners to bring materials. For example, salt.

4.2.3 Analysis of observation data

In the analysis of figure 1 below, the focus is on isolating, examining, and explaining aspects of the teachers’ teaching strategy to understand how the teacher and learners use the available scientific resources to represent meanings.

Figure 4. 1: Teaching strategy



Figure 1 shows that the teacher and learners are foregrounded in the first scene during whole group teaching. In the scene, the desks are traditionally arranged in rows. This arrangement of desks does not allow for pair work or group work within the teaching and learning process. In this scene, the learners focus on the teacher. There are limited resources available for the lesson. Learners do not manipulate the resources and are standing while looking at the teacher.

Teaching strategy

In the observation of lessons, it was revealed that the teacher reads from a textbook and occasionally asks close-ended questions. When a learner does not respond appropriately, the next learner is given the opportunity to provide an answer to a question.

Figure 4. 2: Classroom participation



In the last scene, boys raising their hands are portrayed. This scene shows a question-answer teaching approach. The teacher-centred approach does not allow learners to actively participate in discovery learning. The emphasis is on the teacher and what he teaches. Learners are having a one-time chance of participating in the lesson. This implies that answers are correct or wrong. When triangulating the observation data with teachers and learners interview data, it confirms that science teaching is teacher-centred.

4.2.4 Document analysis

The researcher used the National Curriculum Framework and Science syllabus as secondary data. In a thematic analysis, it was revealed that the most occurring words include verbs such as identity, state, explain, describe, estimate, report, compare. The term ‘investigate’ occurs less than 10 times. One would have expected that more competencies for practical work or investigations would have directed the science syllabus. Furthermore, the general guidelines for assessment are provided. Behaviourism is a worldview that assumes a learner is essentially passive, responding to environmental stimuli (Skinner, 2011). A behaviourist approach does not align with the sociocultural theory of Vygotsky adopted for this study and therefore not with learner-centredness. When triangulating the document analysis with teachers’ and learners’ interview data as well as observation data, it confirms the traditional behaviourist question-answer teaching strategies and approaches toward science education.

4.3 Summary

In Chapter 3, the data collected was analysed and discussed. Thematic analysis, substantiated by the verbatim narratives of the participants, revealed the main factors affecting teachers’ science teaching through codes, categories and themes. The overlapping themes were frequency of practical work, lack of sufficient teaching time, teaching materials, equipment and laboratory facilities, and teaching strategy. In the next chapter, I will interpret the data analysed and make recommendations for further research.

CHAPTER 5

INTERPRETATION AND DISCUSSION OF RESULTS

5.1 Introduction

In Chapter 5, a summary of the qualitative case study data findings is presented. Teachers' teaching beliefs impact teaching and thus science practical work. This study uses Vygotsky's socio-cultural theory as a theoretical framework to discuss practical work in science teaching. This theory allows for learning to be conceived of as shared problem space, inviting learners to participate in a process of negotiation and coordination of knowledge. Haenen et al (2003) argue that learners need a broad framework of concepts to allow them to think, argue, and reason. Teaching plays a pivotal role and makes knowledge possible within sociocultural interaction with peers during practice-based learning in science. The concept of a zone of proximal development (ZPD) explains how more capable learners can provide the necessary scaffolding for new or struggling learners (Vygotsky, 1978). In the following discussion, the data analysis results will be discussed based on the question of the study.

5.2 Research question

What are the factors limiting Grade 7 Natural Science teachers from engaging learners in practical work?

Interviews served as primary data collection tools. The teachers' interview comprised of 10 open-ended questions and nine probing questions. Interviews were audiotaped and data were transcribed. The results revealed the following overlapping themes for discussion:

- a) Practical work
- b) Insufficient teaching time
- c) Facilities, and material
- d) Teaching strategies
- e) Professional development and training, and
- f) Classroom management.

5.2.1 Practical work

The results revealed that participating teachers realized the scope and definition of practical work. In a comment, a teacher states "Teaching and learning Natural Science expose learners to learn

how the world operates. One will get answers on how or why things are happening the way it does.”

From the results, it became evident that teachers did not use any teaching and learning strategies that align with the teaching and learning of practical work, Grade 7. The results further reveal teachers understanding of their role in practical work:

“Practical activities are there to make learners understand better. Practical’s are ways that a teacher uses to back up what she/he has explained to learners theoretically.”

Lee, Quinn, and Valdés (2013) highlight the pressing need for teachers’ science lessons to focus on the language-rich aspects of scientific inquiry and communication for all students that are embedded in scientific practices. With a high value placed upon both scientific knowledge and practices, all learners need teachers who can provide meaningful, authentic, and rigorous opportunities to learn science. Thus, it is imperative that science teacher training programs attend to the wide breadth of knowledge and skills teachers need to enact 21st-century science instruction (Bellanca & Brandt 2010) and meet a modern vision of professional practice (Darling-Hammond & Bransford 2007). The use of scientific inquiry as a teaching paradigm provides learners with more opportunities, not only to engage with scientific questions, make observations, and make meaning from their own experiences, but also to talk with each other and not just their teacher (Baker, Holding & Lewis (2015).

5.2.2 In sufficient teaching time

The analysis of both teachers’ and learners’ interview data revealed that the allocation of time-based on the timetable poses a challenge toward science practical teaching and learning. Teachers’ reflected on the aspect as follow: “Science subjects are given little time compared to other subjects or maybe not compared to other subjects but the nature of the subject itself. Science subjects are not like other subjects e.g. languages, science subjects require learners to have hands-on on certain learning materials.”

Pedagogical planning is an essential step towards the design and construction as well as the presentation of science lessons. Apart from scheduling and timetabling lessons, planning also needs to incorporate teaching strategies (Guillaume, Yopp, & Yopp 2007; Killen 2013), classroom management (Burton, Weston, & Kowalski 2009; Valencia, Martin, Place, & Grossman 2009), pedagogical knowledge practices may include the planning of lessons and preparation of resources that target students’ conceptual development in the science and mathematical areas (Cunningham & Sherman 2008). The implication is that when teachers plan effectively, time would not be a constraint for practical work. Therefore, professional development training is recommended to

enhance teachers' skills on how to utilize the available time for teaching within the timeframe provided for science lessons.

5.2.3 Facilities, and material

The results show that teachers experience challenges with regard to the availability of facilities and resources. The following response confirms this challenge:

“I can say there are not enough materials. All you can find there are only test tubes, balance scales and other common materials. In case of chemicals and other materials... yeah, let me just say there are no materials.”

Preparation of resources is an essential element of teaching (Broek & Kendeou 2008), particularly for science education activities that require hands-on materials for the design and construction of science prototypes. When teachers plan effectively for a skill-development lesson outcome, they are required to organize resources for designing or making products. This resource preparation may motivate learners and instil positive attitudes to engage in practical work. However, the implication is that if there are no resources for practical work, student learning is impeded.

5.2.4 Teaching strategies

The results show that participating teachers have an awareness of the use of alternative teaching strategies that can promote science learning. The following comment is an indication thereof: “The activities that I mostly use include pair work, group discussions and also individual tasks such as classwork and homework.” When using the available resources from the World Wide Web, strategies can involve the use of audio and visual aids (YouTube clips), individual and group work, hands-on (designing, making and testing equipment) and so forth to engage learners in learning. Furthermore, for primary school learners, role play around the three states of matter appeared to instil positive attitudes into learners about their learning. It provides an opportunity for “fun learning” and “helps to understand how the different molecules and particles work. Role play could be a helpful teaching strategy. From a socio-cultural learning perspective, a group work context enables students to interact with others and think about issues in new ways of doing and seeing aspects of practical work. Therefore, the implication is that when teachers have trained appropriately, they could use greater varieties of teaching and learning strategies.

5.2.5 Professional development and raining

Teacher training is important for student learning. The results show teachers' lack of skills and need for training:

“.... meaning one needs to be trained to foster skills on what to do when conducting practical work, especially when handling chemicals and other stuff. I feel they need enough and compulsory training for conducting practical work particularly for the safety of learners and teachers. Also, to ensure that the learners' get the quality education that is aspired. When you can conduct practical successfully it also means you can teach successfully, so it is good for (learners) academic gains” [unknown author].

The implication of the results is that there is a need to engage teachers in science working groups to prepare science lessons and in general, concise pedagogical knowledge of teaching strategies and science knowledge. Furthermore, in the competency-based curriculum of Namibia, general assessment guidelines for teachers are provided. There is a need for training on how to plan for assessment of learning that could include assessment rubrics to locate differentiated outcomes (Hudson 2005). Research shows that training can: 1) align teaching strategies to science activities that elicit particular learner outcomes, 2) determine effective questioning techniques to facilitate learners' conceptual development in science education, 3) present methods for assessing students' science education achievements, and 4) investigate how teachers' viewpoints can influence the learning environment for science education (Hudson et al. 2015).

5.2.6 Classroom management

Classroom management plays an important role to ensure that learners are engaged and benefit from teaching. The respondent confirms that classroom management matters:

“.....Yes, it is easy, because as a teacher you need to have a close eye on your learners and monitor the class. You have to position yourself and see that everyone is involved. I do not think learners will give you a tough time when everyone is actively engaged.”

Effective classroom management has been shown to support student learning at different school levels and in various domains (Hattie 2009). When teachers possess the necessary skills and pedagogical know-how, they may be in a better position to establish routines, classroom rules and strategies to transition swiftly from one activity to the other to ensure productive student learning.

5.3 Summary

In the triangulation of the results, the factors limiting Grade 7 Natural Science teachers from engaging learners in practical work were revealed through themes. These factors were discussed

and suggestions for improvement of practice were outlined. The study uses Vygotsky's theory as a theoretical framework for science teaching. In the next Chapter, the implications for addressing the limitations or challenges of Science teachers and the implications for further research are framed.

CHAPTER 6

IMPLICATIONS AND CONCLUSIONS

6.1 Introduction

Chapter 6 presents the implications of the findings of this research for science practical work and suggests further research for addressing the limitations of this study. This study identified the factors that limit Grade 7 Science teachers from doing practical work. The study addressed the question: What are the factors limiting Grade 7 Natural Science teachers from engaging learners in practical work? Data was collected from schools in the Omusati region. The data collection instruments included semi-structured interviews, classroom observations, and document analysis. The main themes identified from the data include practical work, the frequency of practical work within the daily timetable, teaching strategies, classroom management amongst others. The results show that the factors limiting Science, Grade 7 teachers' teaching include:

- Lack of in-depth knowledge and skills of science curriculum and practical work
- Shortage of facilities, and material
- Teachers lack pedagogical knowledge to apply teaching strategies
- Lack of continuous professional development or explicit training impact teaching and learning

6.2 Factors limiting science practical work

Participating science teachers could not respond as anticipated in a comprehensive way to guide science practices to overcome their limitations when teaching and presenting practical work to Grade 7 learners. In addition, feedback from learners indicated similar themes such as teaching strategies, time constraints, practical work and limitations in terms of materials. The only diverse theme was students' interest in science. Therefore, the following support is recommended to Grade 7 science teachers:

- Lesson planning sessions at school level and in the context of national curriculum requirements for standard-based teaching be organized to support teachers' lesson preparation for science and practical work
- Standards-based teaching and learning give teachers the freedom to utilize additional resources. Therefore, greater access to the Internet should be provided to use a variety of resources and teaching strategies that capture learners' interest and nurture positive attitudes toward science

- Teachers be engaged in explicit science professional development training that equips them with content-specific strategies to unfold teaching and learning processes as well as assessment strategies to assess inquiry-based learning
- Teachers be made aware of what learner-centred education entails in an effort to provide opportunities for learners to engage with each other and the teacher to investigate, explore, experiment and engage in collaborative discussion around scientific concepts and ideas
- Teachers observe each other's teaching in constructive working groups to avoid traditional 'chalk and talk' teaching
- Classrooms arranged in such a way that it supports and provides for collaborative, group work, and peer learning
- Learners allowed to express extended talk and reasoning within the classroom context without being limited by teachers
- When science materials and equipment are not available, teachers be trained to improvise to present lessons without negotiating the quality and standards of education
- Teachers should be trained to create a science corner and a conducive environment for science teaching and learning
- Appropriate budgeting provision made to source materials for practical work

6.3 Recommendations for further research

The study recommends further research to identify training needs to support science specific training and alternative pedagogical approaches that can aid in acquiring teaching skills to improve the quality of teaching outcomes for science learning in the long run. The study also recommends research on specific science teaching and learning processes to promote teacher cooperation on the process of practical work that aligns assessment processes to lesson objectives that support improved quality education in general. It is recommended that teachers start a fund or request a budget to ensure that the necessary materials and resources are purchased to enhance and nurture positive attitudes toward science from an early stage.

6.4 Summary

In an attempt to find out what factors limit science teachers' classroom practice, challenges to teaching were identified. These challenges include lack of pedagogical knowledge of teaching practical work, limited materials and resources as well as training to prepare teachers for their

daily task. These variables are expected to guide stakeholders to develop appropriate strategies to increase the quality of teaching and learning and to nurture future scientists as a result. The results of this study offer evidence that science teachers' participation has led to the development of new insights into the presentation of science practice for Grade 7 learners.

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**Appendix 1: Lesson observation
checklist**

[Please tick in the appropriate column]

Lessons	Require practical work	Does not require practical work	Practical work conducted	Practical work not conducted	Practical materials enough	Practical materials not enough	Learners actively participating	Learners showing little interest
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								

Comments _____

Appendix 2: Interview questions

Dear Participant

The purpose of this interview is to determine the limiting factors that prevent science teachers from doing practical work. Your responses are critical to helping me to realize my study titled “Factors that limit Natural Science, Grade 7 teachers from engaging learners in practical work: A Case Study” Your responses will be treated with confidentiality.

Teacher’s questions

- 1) What do you understand by teaching and learning Natural Science at primary level?
- 2) What pedagogies do you use for teaching Natural Science?
- 3) What kinds of activities do you provide for your learners?
- 4) What is the role of practical activities in teaching and learning Natural Science, according to you?
- 5) How often do you ask your learners to conduct practical activities?
- 6) Can you give me some examples of the types of practical activities you or your learners have done?
- 7) How important is it for the learners to do practical activities themselves to help them learn Natural Science concepts?
- 8) According to you, what factors enable you to teach well?
- 9) What factors hinder teachers to conduct practical work?
- 10) What inhibits learners to participate in practical work?

Probing questions

The main interview questions will be supplemented by the following probable questions:

- 1) Between the subject matter knowledge and pedagogical knowledge, which one is the most important skill for teaching Natural Science? Why?
- 2) Providing the content knowledge of Natural Science using only the lecture method is enough for making students understand. Do you agree or disagree? Why?

- 3) Do you agree or disagree with that practical work makes Natural Science teaching easier? Why?
- 4) Providing theoretical knowledge of Natural Science along with practical activities can ensure effective learning of Natural science. Give your opinion.
- 5) How important is it for the learners to do practical activities themselves to help them learn Natural Science concepts? Why?
- 6) Inquiry-based knowledge is necessary for conducting the practical class. Do you agree or disagree? Explain why
- 7) Practical work makes lessons interesting. What do you think?
- 8) Do you believe that practical activities increase students' motivation towards learning? Give reasons for your answer.
- 9) Does conducting practical work make it difficult to control the class? Why, or why not?
- 10) Do the teachers need training for effectively conducting practical work in school? Why?
- 11) How many Natural Science classes do you take per week?
- 12) Do you have practical classes?
- 13) Are there laboratory assistants or demonstrators in your school for conducting Natural Science practical classes?
- 14) How many practical classes do you or the demonstrators take per week?
- 15) Is there any specific laboratory for Natural Science practical work in your school?
- 16) If no, then where do you conduct practical classes?
- 17) Are there adequate laboratory equipment in your school?
- 18) Do you experience any barrier to conduct practical classes?
- 19) If yes, then what are the barriers?
- 20) What are your suggestions to reduce these barriers?

Learner's interview questions

1. What do you understand by teaching and learning Natural Science at primary level?
2. How often do you carry out practical activities in Natural Science?
3. Do you think it is necessary for Natural Science to teach theory and conduct practical activities again? Explain why

4. As a science learner which part of the lesson you enjoy most? Theory or Practical? Explain why
5. Do you perform better in the practical or in theory part? Explain why
6. Can you give me some examples of the types of practical activities you or your teacher have done?
7. Do you think it is needed for practical hours to be increased? Explain why
8. What do you think can affect practical activities to be conducted on a daily basis?
9. What do you think can be done by either your teachers; school management or the government so that you will be able to do practical work freely and enjoy them at the same time as you wish?

Appendix 3: Unisa ethics clearance certificate



UNISA COLLEGE OF EDUCATION ETHICS REVIEW COMMITTEE

Date: 2017/06/14

Dear Mr Kaindume,

Decision: Ethics Approval from
2017/06/14 to 2020/06/14

Ref#: **2017/06/14/58524665/28/MC**

Name: Mr AN Kaindume

Student#: 58524665

Researcher:

Name: Mr AN Kaindume

Email: appolosk2@gmail.com

Telephone: +26465251267

Supervisor:

Name: Prof A Motlhabane

Email: motlhat@unisa.ac.za

Telephone: 012 429 2840

Title of research:

Factors limiting Science teachers from engaging learners in practical work: A case study

Qualification: M Ed in Science and Technology

Thank you for the application for research ethics clearance by the UNISA College of Education Ethics Review Committee for the above mentioned research. Ethics approval is granted for the period 2017/06/14 to 2020/06/14.

The medium risk application was reviewed by the Ethics Review Committee on 2017/06/14 in compliance with the UNISA Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.

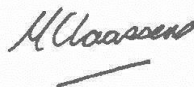
The proposed research may now commence with the provisions that:

1. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.
2. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the UNISA College of Education Ethics Review Committee.
3. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
4. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing.
5. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study. Adherence to the following South African legislation is important, if applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003.
6. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original research. Secondary use of identifiable human research data requires additional ethics clearance.
7. No field work activities may continue after the expiry date 2020/06/14. Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

Note:

*The reference number **2017/06/14/58524665/28/MC** should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.*

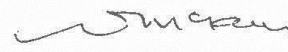
Kind regards,



Dr M Claassens

CHAIRPERSON: CEDU RERC

mcdtc@netactive.co.za



Prof V McKay

EXECUTIVE DEAN

Approved - decision template – updated 16 Feb 2017

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Appendix 4: Parent consent letter

Dear Parent

Your _____<son/daughter/child> is invited to participate in a study entitled: Factors limiting science teachers from engaging learners in practical work: A case study

I am undertaking this study as part of my Master's research at the University of South Africa. The purpose of the study is to find out what are the factors that hinder the smooth running of practical work in schools and how best teachers and learners can overcome these hindrances. The study highlights possible benefits for the improvement of teaching and learning to improve learners progress. The intention is to create awareness to all education stakeholders of the barriers and to present suggestions for the improvement of practical work in one or another way. I therefore request your consent to include your child in this study.

If you allow your child to participate, he/she will be engaged into:

- An interview

The interview will use semi-structured questions. Your child will be expected to participate in a face-to-face interview. Interviews are planned at the school and follow up questions will also be at the child's school. The total length of the interviews will be approximately 15 minutes long.

- The interviews will be audio-taped. A video recording of your child's lessons will also take place.

Since the interview will be audio recorded and the classroom presentation will be video recorded, you are hereby requested to grant permission for your child to be recorded by filling the return slip below.

I, (name of parent)agree/disagree (delete inappropriate), that my child may participate in this study.

Signature.....

Any information that is obtained in connection with this study and that can be identified with your child will remain confidential and will only be disclosed with your permission.

His/her responses will not be linked to his/her name or your name or the school's name in

any written or verbal report based on this study. Such a report will be used for research purposes only.

There are no foreseeable risks to your child's participating in this study. Your child will receive no direct benefits for participating in the study; however, the possible benefits to education are improvements of teaching and learning methods in Natural Science as a subject which at the end improves the learners understanding and performance of the subject. Neither your child nor you will receive any type of payment for participating in this study.

Your child's participation in this study is voluntary. Your child may decline to participate or withdraw from participation at any time. Withdrawal or refusal to participate will not affect him/her in any way. Similarly, you can agree to allow your child to be in the study now and change your mind later without any penalty.

The study will take place during regular classroom activities with the prior approval of the school and your child's teacher. However, if you do not want your child to participate, an alternative activity will be available for non-participating learners after school just to capture what others have done during the lesson which was part of the study.

In addition to your permission, your child must agree to participate in the study and you and your child will be requested to sign the assent form which accompanies this letter. The information gathered from the study and your child's participation in the study will be stored securely on a password locked computer in my locked office for five years after the study. Thereafter, records will be erased.

The benefits of this study are that learners of Natural Science will get some factors limiting the smooth engagement in practical work and how best to overcome them and there are no known or anticipated risks to the learner as a participant in this study.

If you have questions about this study please do not hesitate to ask me or my study supervisor, Prof A. T Motlhabane, Department of Department of Science and Technology Education, College of Education, University of South Africa. My contact number is +264 81 7500 689 and my e-mail is apollosk2@gmail.com . The e-mail of my supervisor is motlhat@unisa.ac.za . Permission for the study has already been granted by the principal and the Ethics Committee of the College of Education, UNISA.

Your signature below indicates that you have read the information provided above and have decided to allow your child to participate in the study. You may keep a copy of this letter.

Name of child:

Sincerely,

Parent/guardian's name (print) Parent/guardian's signature: Date:

Researcher's name (print) Researcher's signature Date:

Appendix 5: Participant information sheet.

7 May 2017

Title: Factors limiting science, Grade 7 teachers from engaging learners in practical work: A case study

Dear Participant,

My name is Appollos N Kaindume and I am doing research under the supervision of Prof A. T. Motlhabane a professor in the Department of Department of Science and Technology Education towards a M Ed degree at the University of South Africa. We are inviting you to participate in a study titled: Factors limiting science, Grade 7 teachers from engaging learners in practical work: a case study.

What is the purpose of the study?

This study is expected to collect important information that could help educational stakeholders to recognize the challenges that may hinder the smooth running of practical work in schools and how best they can maneuver those challenges to ensure that learners are not only learning theory but exploratory hands-on too.

Why am I invited to participate?

You are invited because you qualify based on your subject field and years of experience of teaching science to be a participant in this study.

I obtained your contact details from your school principal through the office of the inspector of Ogongo circuit. The research is planned to include two teachers, one teacher per school from different schools in Ogongo circuit who are willing to present three science lessons for observation purposes for at least 30 participating learners in such class.

What is the nature of my participation in this study?

Describe the participant's actual role in the study.

The study involves audio and video recording of interviews and observations. The interview questions will be semi-structured to find out what are the real challenges faced by the participants when planning for practical work and when conducting practical work and how the participant tried to overcome these challenges. The participation in this study

will take you approximately an hour (60 minutes), 40 minutes for the observation of your lesson and 20 minutes for the interview.

Can I withdraw from this study even after having agreed to participate?

Participating in this study is voluntary and you are under no obligation to consent to participation. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a written consent / assent form. You are free to withdraw at any time and without giving a reason.

What are the potential benefits of taking part in this study?

By taking part in this study, you are helping the Ogongo circuit and the Namibian nation at large to identifying some challenges teachers and learners face when conducting practical work. Also, you will help the study to suggest some possible solutions to the problems faced in practical works. As a participant in this study you will be the first person to learn on the best ways found to tackle practical work under different circumstances.

Are there any negative consequences for me if participate in the research project?

There are no known or anticipated negative consequences to you as a participant in this study.

Will the information that I convey to the researcher and my identity be kept confidential?

You have the right to insist that your name will not be recorded anywhere and that no one, apart from the researcher and identified members of the research team, will know about your involvement in this research. Your answers will be given a code number or a pseudonym and you will be referred to in this way in the data, any publications, or other research reporting methods such as conference proceedings.

Your answers may be reviewed by people responsible for making sure that research is done properly, including the transcriber, external coder, and members of the Research Ethics Review Committee. Otherwise, records that identify you will be available only to people working on the study, unless you give permission for other people to see the records.

A report of the study may be submitted for publication, but individual participants will not be identifiable in such a report.

How will the researcher (s) protect the security of data?

Hard copies of your responses will be stored by the researcher for a period of five years in a locked cupboard for future research or academic purposes; electronic information will be stored on a password protected computer.

Will I receive payment or any incentives for participating in this study?

You will not be reimbursed or receive any incentives for your participation in the research.

Has the study received ethics approval?

This study has received written approval from the Research Ethics Review Committee of the *College of Education*, Unisa. A copy of the approval letter can be obtained from the researcher if you so wish.

How will I be informed of the findings/results of the research?

If you would like to be informed of the final research findings, please contact Mr Appollos N Kaindume on +26481 7500 689 or email apollosk2@gmail.com. The findings are accessible for a period of 5 years.

Should you have concerns about the way in which the research has been conducted, you may contact Prof A. T. Motlhabane 012 429 2840 email motlhat@unisa.ac.za.

Thank you for taking time to read this information sheet and for participating in this study.

Yours truly,

Signature

Appollos N Kaindume

CONSENT/ASSENT TO PARTICIPATE IN THIS STUDY (Return slip)

I, _____ (participant name), confirm that the person requesting my consent to take part in this research has informed me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable).

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I agree to the recording of the interviews and classroom observation.

I have received a signed copy of the informed consent agreement.

Participant name & surname (please print) _____

Participant signature

Date

Researcher's Name & Surname (please print) _____

Researcher's signature

Date

Appendix 6: Circuit inspector's request for permission to conduct research in Ogongo circuit schools

Title: Factors limiting science teachers from engaging learners in practical work: A case study

Mr Kamati

Ogongo circuit Inspector

+26465448934

7 May 2017

Dear Mr Kamati,

I, Appollos N Kaindume am doing research under supervision of Professor A. T.

Motlhabane, a professor in the Department of Science and Technology Education towards a M Ed degree at the University of South Africa. We are inviting you to participate in a study titled "FACTORS LIMITING SCIENCE, GRADE 7 TEACHERS FROM ENGAGING LEARNERS IN PRACTICAL WORK: A CASE STUDY."

The aim of the study is to determine factors limiting science teachers from engaging learners in practical work.

Three schools from your circuit (School W, School X and School Y) have been selected because they are some of the schools in Ogongo circuit offering Natural Science as a subject.

The study will entail observations and interviews on practical activities on Natural science at primary level.

The researcher will observe the teachers three times in Natural science lessons.

I will interview the teachers once after the first participant observation and once after the last participant observation. I will provide the teacher with probable interview questions before hand so that he/she will have enough time for thinking in order to give detailed information about the topic. Each interview will take approximately 20-30 minutes.

The benefits of this study are that it will awaken learners and teachers of Natural science at schools about the importance of practical work in the teaching and learning process. The findings from this study will be used as a tool to inform all the educational stakeholders about the challenges schools face when exercising the syllabus in terms of practical work. Learners, teachers, parents and principals will get some suggestions on possible actions to

be taken when one comes across one or two of the factors limiting the engagement of learners in practical work.

There are no potential risks in this study.

There will be no reimbursement or any incentives for participation in the research.

A copy of the thesis will be given to each of the schools that took part in the research and a summary of the findings and recommendations will be discussed with the NSHE teachers and learners of the schools that took part in the research. The thesis will also be available at the library at Okahao community library. Feedback on the final results of the study will also be given on participants requests. For Feedback participants can contact the researcher on +26481 7500 689 email: apollosk2@mail.com.

Yours sincerely



Appollos N Kaindume

Teacher- Eendombe Combined School

Appendix 7: Principals request for permission to conduct research at their schools

Title: FACTORS LIMITING SCIENCE TEACHERS FROM ENGAGING LEARNERS IN PRACTICAL WORK: A CASE STUDY

Appollos N Kaindume
P. O. Box 25026
Onandjokwe
Cell: + 26481 7500 689

The Principal

School X

08 August 2017

Dear Sir/Madam

I, Appollos N. Kaindume am doing research under supervision of Professor A. T. Motlhabane, an associate professor in the Department of Science and Technology Education towards a M Ed degree at the University of South Africa. We are inviting you to participate in a study titled “FACTORS LIMITING SCIENCE TEACHERS FROM ENGAGING LEARNERS IN PRACTICAL WORK: A CASE STUDY.”

The aim of the study is to determine factors limiting science teachers from engaging learners in practical work. Your school have been selected because it is one of the schools in Ogongo circuit offering Natural Science as a subject. The study entails observations and interviews on practical activities on Natural Science at primary level. I will observe the teacher three times in Natural Science lessons.

I will interview the teacher once after the first participant observation and once after the last participant observation. I will provide the teacher with probable interview questions before hand so that he/she will have enough time for thinking in order to give detailed information about the topic. Each interview will take approximately 20-30 minutes.

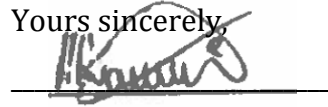
The benefits of this study are that it will awaken learners and teachers of Natural Science at schools of the importance of practical work in the teaching and learning process. The findings from this study will be used as a tool to inform all the educational stakeholders

about the challenges school face when exercising the syllabus in terms of practical work. Learners, teachers, parents and principals will get some suggestions on possible actions to be taken when one comes across one or two of the factors limiting the engagement of learners in practical work. There are no potential risks in this study.

There will be no reimbursement or any incentives for participation in the research.

A copy of the thesis will be given to each of the schools that took part in the research and a summary of the findings and recommendations will be discussed with the NSHE teachers and learners of the schools that took part in the research. The thesis will also be available at the library at Okahao community library. Feedback on the final results of the study will also be given on participants requests. For feedback participants can contact the researcher on +26481 7500 689 email: apollosk2@mail.com.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'Appollos N Kaindume', is written over a horizontal line.

Appollos N Kaindume (Teacher –Eendombe Combined School)

Appendix 8: Consent letter for teachers

Dear Mr./Mrs. X

This letter serves as an invitation to consider your participating in a study. I, Appollos Kaindume is conducting a study as part of my research as a Master's of education student titled, 'Factors limiting science, Grade 7 teachers from engaging learners in practical work: a case study' at the University of South Africa. Permission for the study has been granted by the Department of Education and the Ethics Committee of the College of Education, UNISA. I have purposefully identified you as a possible participant because of your valuable experience and expertise related to my research topic.

I would like to provide you with more information about this project and what your involvement would entail if you should agree to take part. The results of this study are important as it would inform the policy makers of the hindrances that prevent teachers from conducting practical work. Thus, they can come up with possible solutions to these hindrances. Teachers will benefit as they would become aware of the different ways to improve their practical work in the teaching and learning process.

In this interview I would like to have your views and opinions on this topic. This information can be used to improve teaching and learning of Natural Science specifically for presenting practical work.

Your participation in this study is voluntary. It will involve an interview of approximately 20-30 minutes in length. It will take place in a mutually agreed upon location at a time convenient to you. You may decline to answer any of the interview questions if you so wish. Furthermore, you may decide to withdraw from this study at any time without any negative consequences.

With your kind permission, the interview will be audio-recorded to facilitate collection of accurate information and later transcribed for analysis. Shortly after the transcription has been completed, I will send you a copy of the transcript to give you an opportunity to confirm the accuracy of our conversation and to add or to clarify any points. All information you provide is considered completely confidential. Your name will not appear in any publication resulting from this study and any identifying information will be omitted from the report. However, with your permission, anonymous quotations may be used. Data

collected during this study will be retained on a password protected computer for 5 years in my locked office.

The benefits of this study are that teachers and learners of Natural Science will get some factors limiting the smooth engagement in practical work and how best to overcome them.

There are no known or anticipated risks to you as a participant in this study. You will not be reimbursed or receive any incentives for your participation in the research.

The findings are accessible for one –two months after this study is done.

If you have any questions regarding this study, or would like additional information to assist you in reaching a decision about participation, please contact me at +2648117500689 or by e-mail apollosk2@gmail.com , or my supervisor prof Abraham Motlhabane at 012 429 2840 email motlhat@unisa.ac.za .

I look forward to speaking to you and thank you in advance for your assistance in this project. If you accept my invitation to participate, I will request you to sign the consent form.

Yours sincerely,

Appollos N Kaindume



27/07/2017

Appendix 9: Permission letter from Ogongo circuit.



REPUBLIC OF NAMIBIA



OMUSATI REGIONAL COUNCIL

DIRECTORATE OF EDUCATION, ARTS AND CULTURE *Team Work and Dedication for Quality Education*

Tel: +264 65 251700

Fax: +264 65 251722

Private Bag 529

OUTAPI

Enq: Simeon Shilulu

18 August 2017

Mr. Appollos N Kaindume
P.O. Box 25026
Onandjokwe

Subject: Request for permission to conduct research in Ogongo Circuit schools for Master Degree in Education

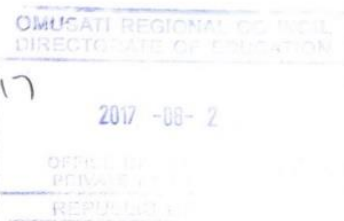
This letter serves to notify you (**Mr. Appollos N Kaindume**) that permission has been granted to conduct research in three schools of Ogongo Circuit (**██████████ Combined School, ██████████ Combined School and ██████████ Combined School**) regarding **"FACTORS LIMITING SCIENCE TEACHERS FROM ENGAGING LEARNERS IN PRACTICAL WORK: A CASE STUDY."** Please be informed that the research to be conducted at schools should by no means whatsoever disrupt teaching and learning. Furthermore, be informed that the collected information should be used for the intended purpose only.

We hope and trust this exercise will enhance quality education in the Region.

Yours faithfully

Mr. Laban Shapange
Regional Director

24/08/17



Cc: Inspectors of Education, Ogongo Circuit

All official correspondence must be addressed to the Chief Regional Officer.

Appendix 10. Language editing Certificate.

DiVille Enterprises cc



DiVille Research Consultancy Services

Language editing Certificate

Annaly Strauss

Managing Director

Cell: 081 360 8555

081 777 8008

Email: straussam10@gmail.com

P.O.Box 24175

Windhoek

Namibia

Diville Research and Consultancy Services

Ref. 180320129/1

To Whom It May Concern

I have refined and edited the Master's Thesis of **Appollos N Kaindume** which will be published by UNISA.

Editing included the following services to the document:

- Correcting grammar and syntax to align with academic writing style
- Elaborating key aspects for clarity
- Reviewing References

Thanking you,

Annaly M. Strauss (PhD)